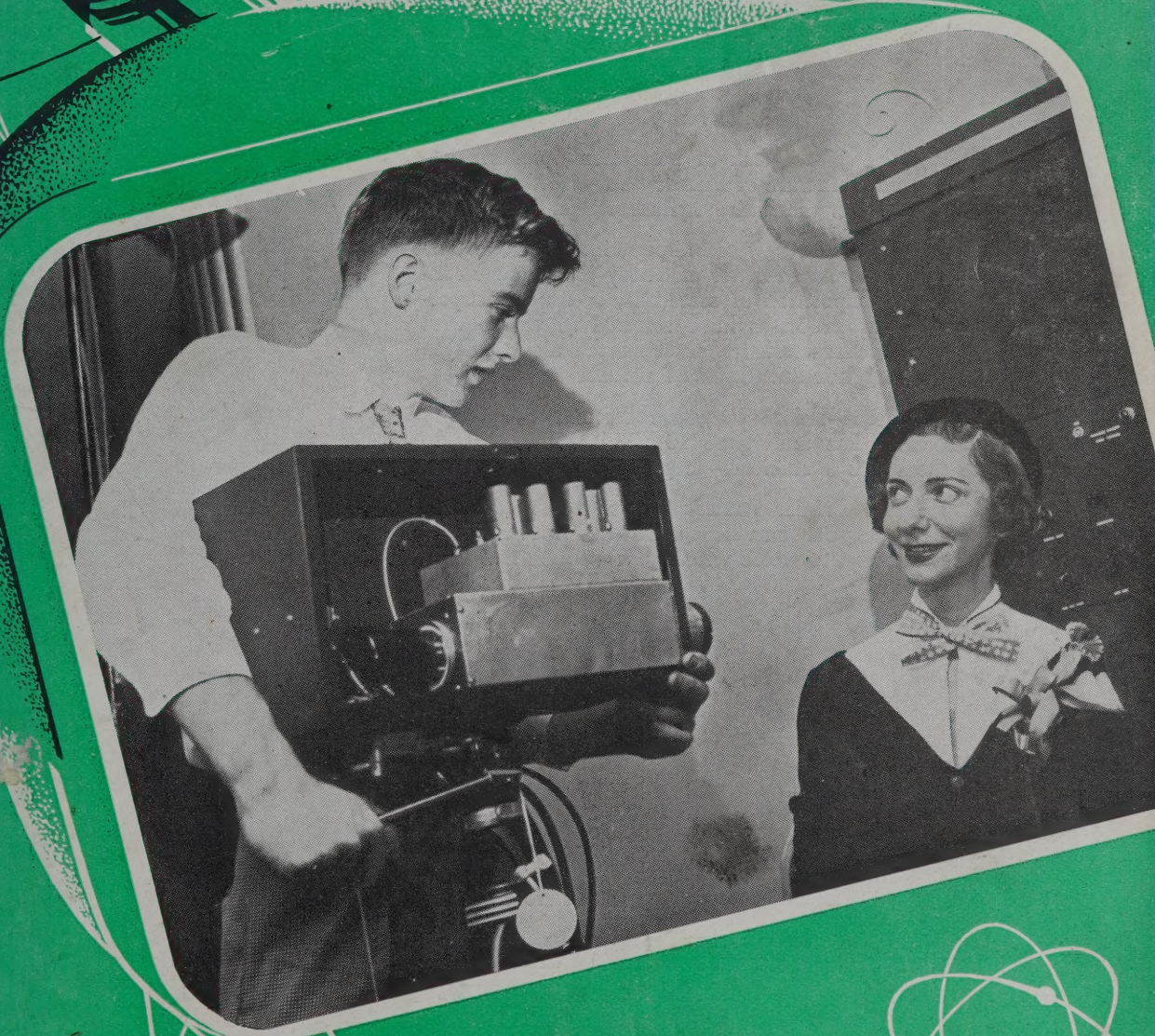
RADIO and ELECTRICAL Review

TELEVISION - COMMUNICATIONS - SERVICE - SOUND

Incorporating "RADIO and ELECTRONICS"



JANUARY 1st 1955

VOL. 9, NO. 11

PRICE 1/10

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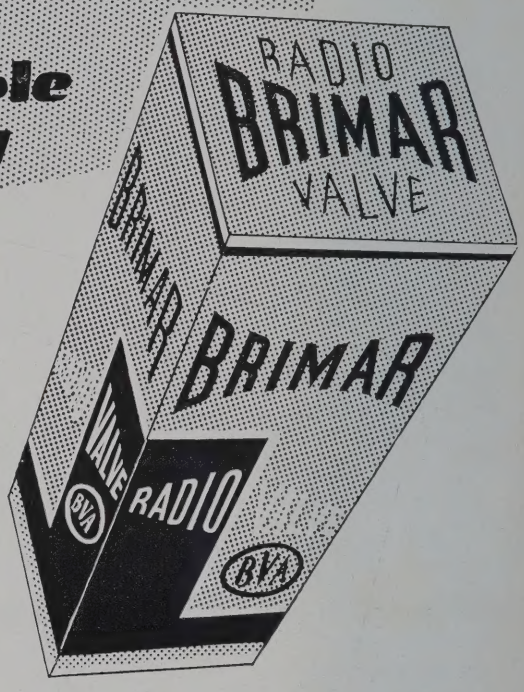
Now more reliable than ever!



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STC

Radio and Electrical Review

OUR COVER PICTURE

Our cover picture this month shows Donald Trumbul, of Milford, Connecticut, who won first prize in the electronics division of the eighth annual Industrial Arts Awards contest sponsored by the Ford Motor Company. Donald is shown demonstrating his closed circuit television unit.

Because of its own international nature, the Ford Company expects to open the arts competition to all students of the free world during 1955.

●

Official Journal of
The N.Z. Electronics Institute (Inc.).
The N.Z. Radio and Television Manufacturers' Federation.
The N.Z. Radio and Electrical Traders' Federation.
N.Z. Radio, TV and Electrical Assn. (Inc.).

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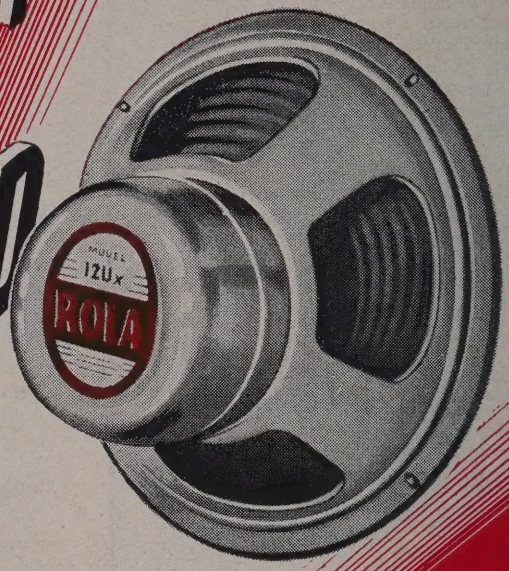
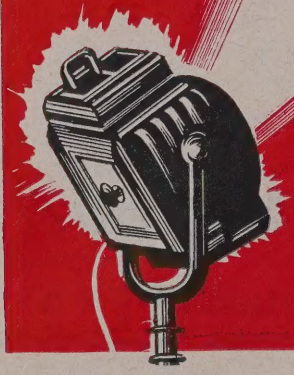
SPOTLIGHT ON SOUND





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Laboratory Notes

from BEACON RADIO LTD.

No. 23

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When dealing with such things as the whys and wherefores of electrical circuits it is at times necessary to use words that have a special technical meaning. The mere use of words explains nothing. Technical words define things nicely providing that both writer and reader place the same meaning upon them. The essence of the successful communication of complex ideas is for both writer and reader to speak the same language.

BEACON technical descriptions are intended to be factual and accurate. No attempt is made to cloud the issue with a multitude of technical irrelevancy. BEACON are always pleased to discuss points with customers and are prepared to back up their statements with actual measurements. Customers' detailed specifications are welcomed, providing that they are based on sound engineering practice.

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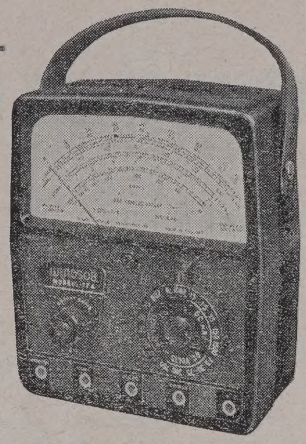

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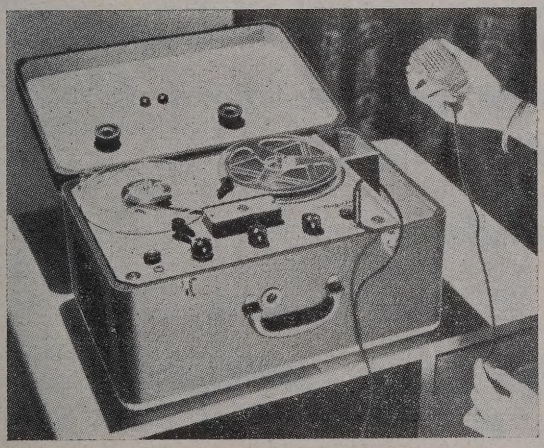

gives
High-fidelity Reproduction with Simplicity of Operation

★ Extremely portable ★ Records anything
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No tracks, no needle . . . no scratch, no wear. Supplied in two models, each complete with microphone, spool of tape and empty spool.

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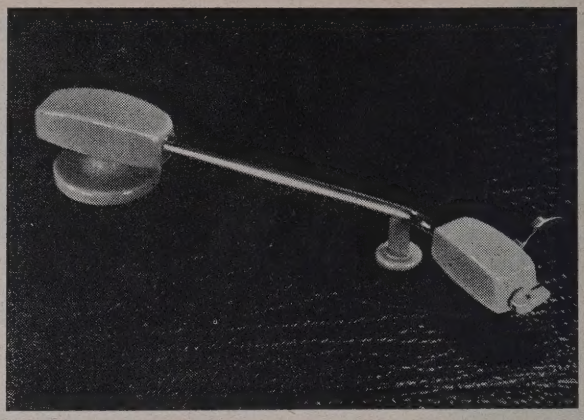
Picture of the month

What is it?



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Complete with TO 284 P or TO 284 OV Cartridge.

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As described in November issue of "R. & E."

KIT OF PARTS: £8/5/-

Also available

"ROLA" MODEL 6L, 39s. 7d. each

suitable for use in the speaker arrangement "High Fidelity at Low Cost," which also appeared in the November issue.

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Fitted on any car in any position in five minutes

It can be mounted on any part of the car—whether flat or curved. Moreover, because of a special split-washer device and self-positioning sleeve incorporated in its design, it can be completely FITTED FROM THE OUTSIDE by one man in five minutes.

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- **POSITIVELY FREE FROM RATTLE**
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Extended, 62 in.; closed, 24 in.

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All exposed parts heavily chromium-plated and with fully weather-proofed connections.

Complete with 36 in. low-loss co-axial polythene insulated P.V.C. covered cable, fitted with standard co-axial plug.

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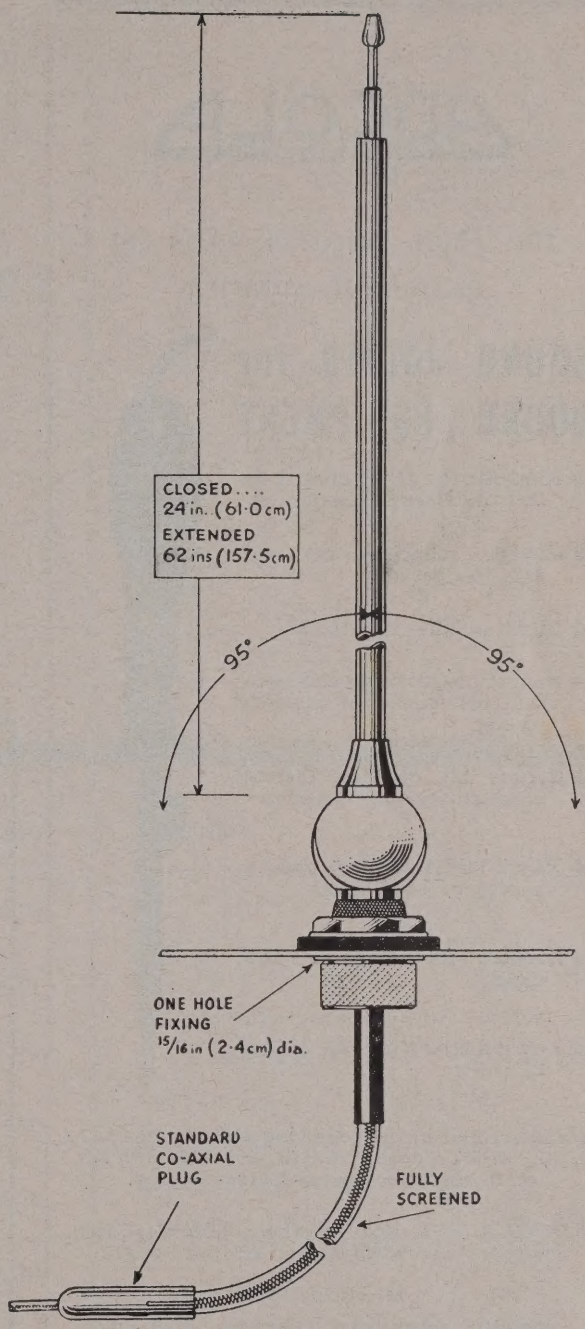

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1200 ft. and 600 ft. spools with "universal" hub, perfect balance and negligible rotation noise.

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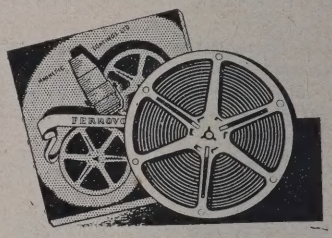
34s. 6d. and 23s. 9d. Retail.
Trade Inquiries Invited



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Make every minute of your precious holiday time count. Your journey, too, can be part of your holiday—if you go by train.

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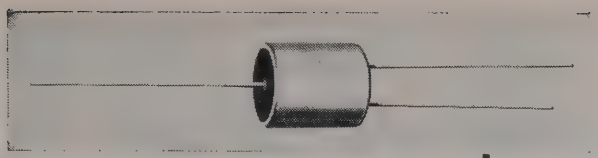
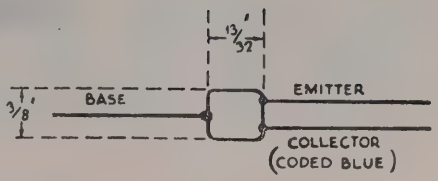


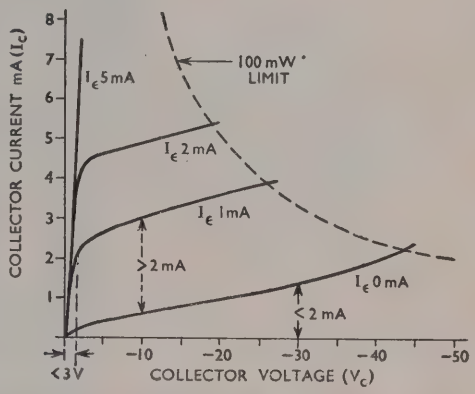


G.E.C.

Germanium Triode GET 1

POINT CONTACT TYPE

now available to all electronic equipment manufacturers



Many progressive designers have made full use of the range of G.E.C. germanium diodes to save power consumption and space.

Now the release of the GET 1 — a germanium triode (transistor) of the point contact type — will enable more designers to reap the benefits of this important development in radio and electronic engineering, where the potentialities of the GET 1 are manifold.

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RATING

V_c (collector voltage) for short-circuit stability at $V_e = 0$*	−30 max.	V
V_c (DC)	−50 max.	V
I_c (collector current) DC	15 max.	mA
T_{op} (operating temperature)	35 max.	°C
p_c (collector dissipation)	100 max.	mW

Subject to p_c max. not being exceeded.

*V_e = emitter voltage.

CHARACTERISTICS

I_c at $V_c = -30$, I_e (emitter current) = 0	2 max. 1 average	mA mA
V (at $I_c = 2$ mA)	3 max. 1.5 average	V V
I_{gain} at $V_c = -10$, I_e range 0–1mA	2 min. 2.5 average	

GENERAL The GET 1 is hermetically sealed in a metal can, which is insulated from the electrodes. The can may be earthed when necessary.

BRITISH GENERAL ELECTRIC COMPANY LIMITED Wellington, Auckland, Christchurch Dunedin

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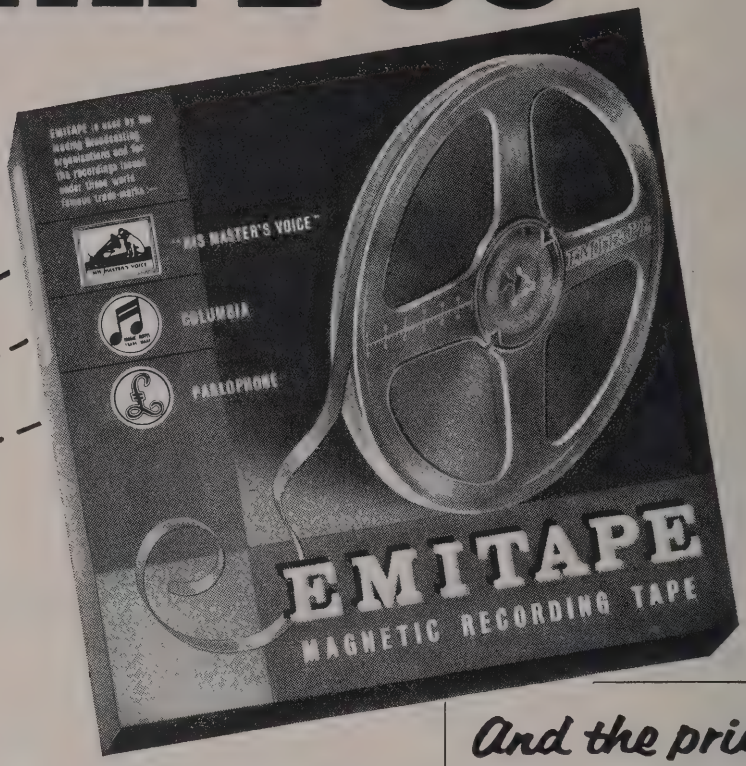

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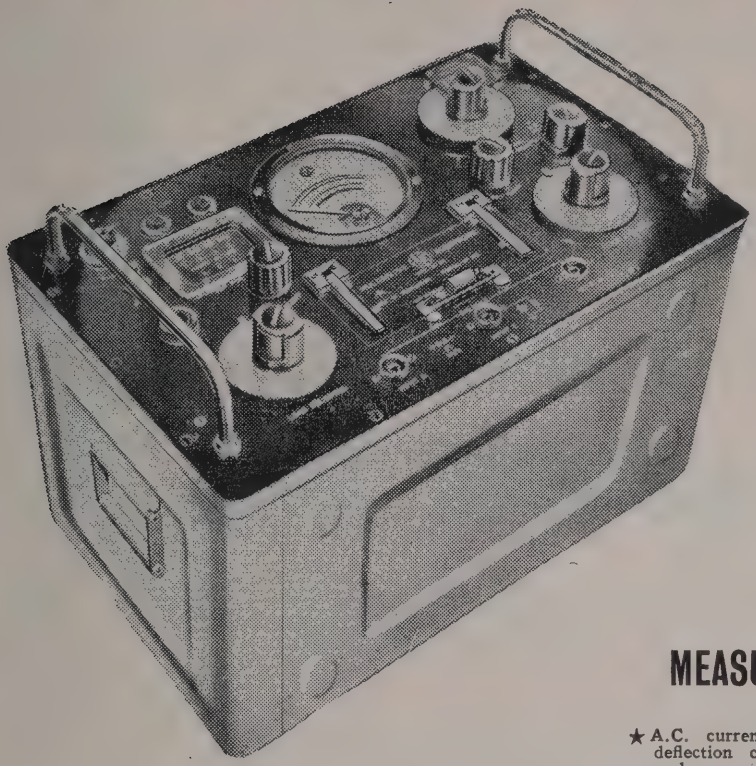

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★ A 95 range laboratory Electronic Multimeter, robust as a normal portable testmeter.

★ Pan-climatic design enables this instrument to operate under the most arduous climatic conditions. The testmeter complies with the Inter-Services Specifications K114 and RCS-1000.

★ Maximum sensitivity of 40 Megohms/V on D.C. voltage ranges.

★ Voltage measurements over a wide frequency range up to approximately 250 Mc/s, together with high input resistance, and low capacitance on A.C. voltage ranges.

★ A linear scale is used for all A.C. and D.C. measurements.

★ No internal batteries are incorporated, or external batteries required to energize the "ohms" ranges.

★ A.C. current readings down to 10μA full scale deflection can be obtained on a virtually linear scale over a wide frequency range.

★ The movement is automatically protected against overload or misuse.

★ A wide range (60dB total) of output power measurements extending up to low radio frequencies is obtainable.

★ Two-terminal (with respect to Earth) balanced voltages, or three-terminal differential voltages can be measured, thus rendering the instrument particularly suitable for use with Frequency Modulated Radio Receivers, Automatic Frequency Control Circuits, Servo Mechanisms, etc.

★ The incorporation of an electronically stabilised H.T. supply together with the use of balanced circuits employing a high degree of negative feed-back, render the instrument highly stable despite "mains" supply fluctuations.

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AND ENGINEERING COMPANY LIMITED

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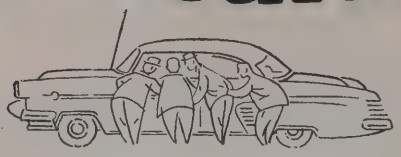
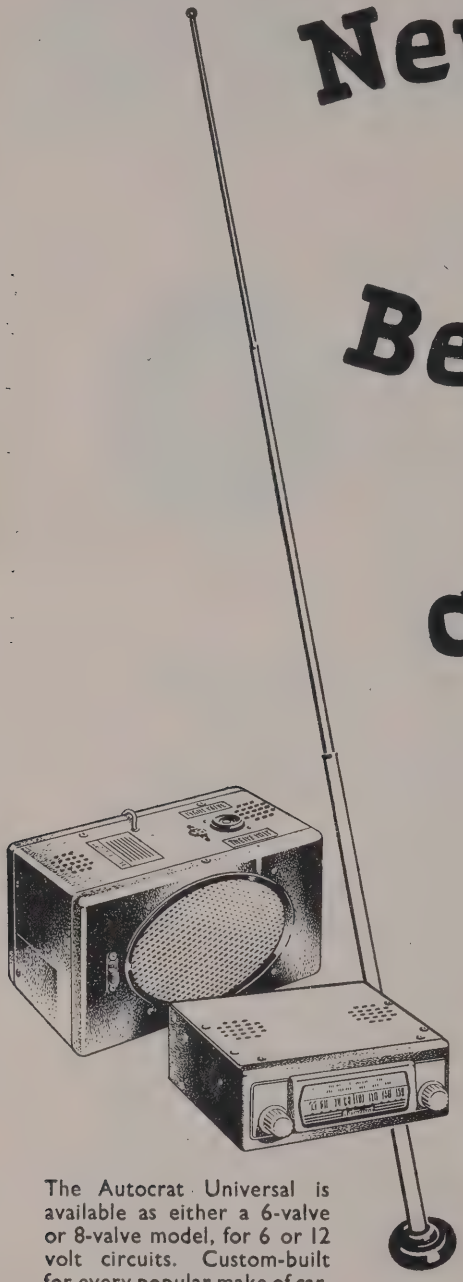
New Zealand's



Best Selling

car radio



You'll get twice the pleasure out of motoring when you fit an Autocrat. Most popular car radio because it gives you so much more—in range, performance, *and* value.

The Autocrat Universal is available as either a 6-valve or 8-valve model, for 6 or 12 volt circuits. Custom-built for every popular make of car.

Autocrat

CAR RADIO

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A.1

ERNEST TURNER . . .

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TAPE RECORDER WITH PUBLIC ADDRESS SYSTEM.
FAST FORWARD AND RE-WIND.

Supply—200-240 volts.

Consumption—75 VA with motor running.

Playing Time—half hour.

Power Output—2¾ watts.

Speaker—Philips 6 in.

Valves—6SL7, pre-amplifier, 6 X 5 rectifier 6SN7, Oscillator, 6F6 output.

Controls—as illustrated.

FULL RETAIL **Price £79/10/-**

(PLUS MICROPHONE—CHOOSE YOUR OWN)

Distributorships available

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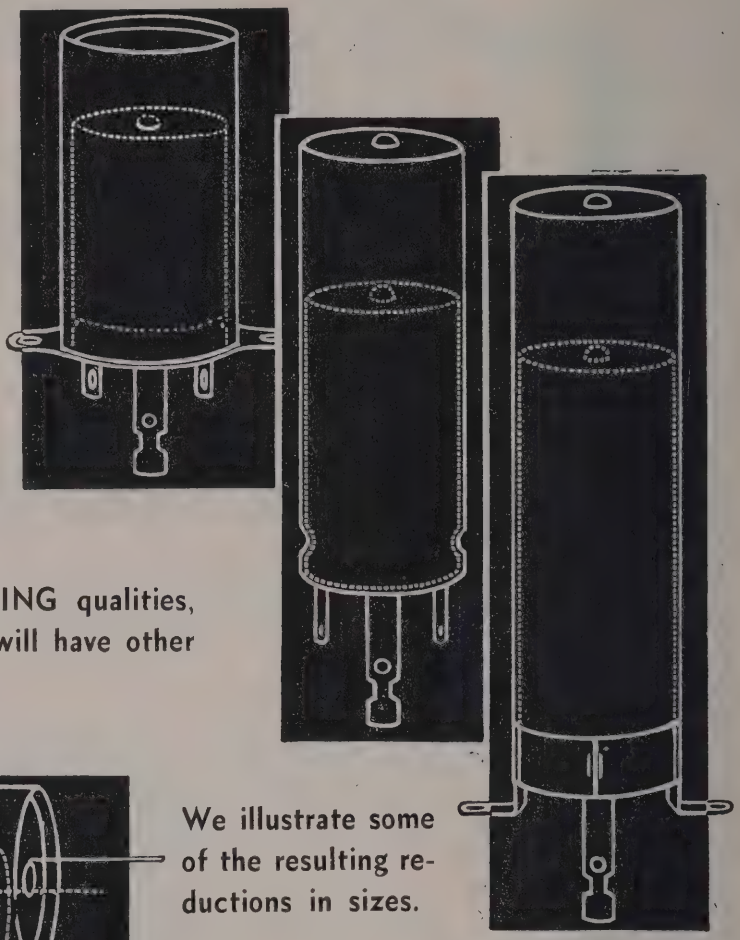
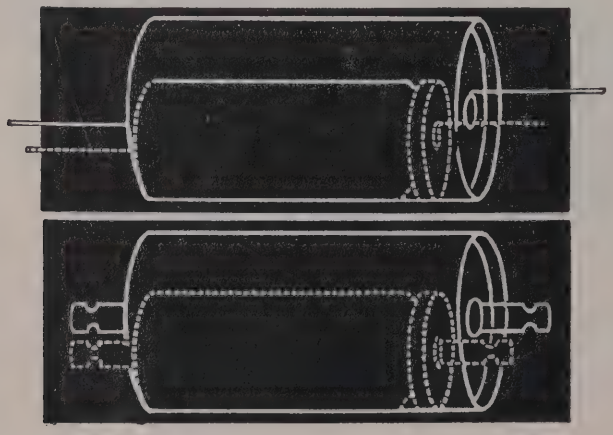
DUCON *ELECTROLYTICS*

REDUCED SIZES

Using MALLORY techniques, DUCON are reducing the physical sizes of ELECTROLYTIC CAPACITORS. Data Sheets are being prepared for early release.



In addition to the SPACE-SAVING qualities, this new range of Electrolytics will have other improved characteristics.



We illustrate some of the resulting reductions in sizes.

BENEFIT FROM DUCON'S WORLD WIDE ORGANISATION

DUCON (N.Z.) LTD., WELLINGTON

WORKS: 26 WRIGHT STREET, TELEPHONE 52-905.
OFFICE: 21 GREY STREET, P.O. BOX 630, TELEPHONE 42-411.

Now-A Smarter TWO TONE

PACEMAKER 'LEADER'

GREY AND IVORY

BURGUNDY AND IVORY

PASTEL GREEN AND IVORY

PASTEL BLUE AND IVORY

RED AND IVORY

ALL IVORY

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A New Idea In Television

Elsewhere in this issue, readers will find an announcement that a well-known Australian firm and its New Zealand subsidiary have acquired an interest in the right to the American firm of Zenith's subscription television. Stated baldly like this, it does not perhaps sound very exciting, but the implications of this step are quite far-reaching. First of all, what is subscription television? It is a scheme whereby viewers are able to use certain television programmes only if they subscribe to the cost of producing them. In its most obvious form, subscription television is worked by "piping" the signal over the lines to the subscribers' homes, where they have receivers which are the property of the concern which provides the programmes, and for which they pay a hiring fee. Alternatively, and even concurrently, certain of the programmes are "scrambled," so that they cannot be properly seen. To view them, the subscriber must pay a fee, for which he obtains the necessary de-coding information. This enables him to so to set a de-coder, which is part of his receiving equipment, that the picture is unscrambled. In the form just described, there are two salient features of subscription TV. One is that it is not broadcast, in the sense that anyone with a standard type of receiver can pick it up and enjoy it. The necessity for hiring the special receiving equipment, and/or having to pay for the de-coding information, ensures that those who view the programmes are the ones who pay for them. This is vastly different from broadcasting, where anyone who likes to buy a receiver may view anything that is being transmitted in his area. When TV is commercial, no licence fees are paid, so that the cost of the programmes and the running of the transmitting end generally is borne not only by those who buy television sets, but by all those who use the products which are advertised on the TV programmes, whether or not they have a set themselves, or are able to receive any programmes. Subscription television, therefore, is an embodiment of the principle that the user pays. Now the use of this principle brings out several possibilities that do not exist when the public at large is paying for the TV transmissions, either through advertising, or through taxation, which is partly how they pay when the service is government-run. The most important one is that those who take upon themselves the responsibility for providing the programmes are given a freer hand. It is claimed, for example, that certain types of programmes which are much too expensive for broadcasting stations to use can be afforded by those turning on subscription TV. For instance, it might be possible for them to conclude an agreement with the motion-picture industry to allow films which are currently showing to be put over the subscription TV, and similar situations might easily occur where sporting bodies like the Rugby Union might want a higher fee for the television rights for their matches than TV broadcasting stations are able to afford.

The Zenith Corporation, in America, has for some time been engaged in subscription TV activity, and has developed it on the technical side so that it is no longer necessary for the signal to be wired to the viewer's homes. The programmes are transmitted over the air, and are picked up on a conventional TV receiver, to which a special attachment has been added. This attachment does not prevent the "free" programmes, broadcast by other organizations from being received, but is essential if the subscription TV programmes are to be unscrambled. Thus, the subscription TV works alongside TV broadcasting, without itself being broadcast in the accepted sense of the term.

But, you might say, where is the essential difference? If the subscription programmes are transmitted over the air, surely they are "broadcast?" The point depends on the exact meaning of the word "broadcasting," which implies not only that the transmission is sent out by radio so that it can be received anywhere within the service area of the transmitter, but also that it is open to anyone who likes to buy a receiver to use the transmissions. The subscription transmissions are not broadcast in this sense, because they can be received properly only by those with the necessary de-coding equipment, who have paid for the privilege of being able to unscramble the transmission. The system is really as private as if it were distributed by private wires, like the telephone service.

No doubt there will be many who will argue the pros and cons of a system such as the one we have described. Clearly, it would find itself in competition with anyone engaging in TV broadcasting proper. It would compete for viewers, and for programme material, and it seems to us that its greatest advantage is that it provides the possibility, at least, of television programmes being turned on at no cost to anyone but those who wish to make use of them.

AUDIO

THE "R. & E." ALL-PUSH-PULL AMPLIFIER

A few months back we introduced the subject of all-push-pull amplification to readers in our "For the Experimenter" series. The idea seems to have appealed to a number of readers, and so we have taken it a little further in this article, which gives a practical circuit that can easily be adapted to use other tube types than those specified. The arrangement described has some very novel features.

INTRODUCTION

In the April and May issues of "Radio and Electrical Review," we printed two short articles on the subject of push-pull input circuits, showing how it is possible to have an amplifier which is push-pull in every stage, provided that a balanced signal source is available. In the former issue, it was shown that the conventional diode detector of the ordinary radio set can be converted to give balanced outputs, suitable for feeding into an all-push-pull amplifier, while in the May issue, an arrangement was given which enables the volume to be controlled in an all push-pull amplifier, without the necessity for ganged potentiometers. These ideas created considerable interest among our readers, judging from the enquiries received, and we thought it would be helpful if it were carried several stages further. The outcome is the present article, which describes a practical design for an all push-pull amplifier, using inexpensive and easily obtained valves. In addition, there is no reason why the basic arrangement shown should not be modified in a number of ways, to suit other valve types, or in order to give alternative arrangements, more suited to a particular purpose.

VIRTUES OF PUSH-PULL

No one will be found with the desire to decry push-pull amplifiers, as such, for their advantages are sufficiently numerous to have made push-pull output stages standard, for amplifiers with any pretensions to high quality. This immediately poses the question, "Are not the advantages of push-pull such that it would pay to make all the stages of an amplifier this way?" Theoretically, of course, the answer must be in the affirmative, because what is good for the output stage must automatically be good for the preceding voltage amplifier stages too. However, there are certain things which make the advantages less pronounced, if push-pull connection is applied to the earlier stages. An obvious one is that the voltage amplifier stages are operating at much lower levels than the output stage, so that their distortion is much smaller in any case. Thus, the argument goes, any decrease of distortion here, must have a smaller overall effect in improving the amplifier than does giving it a push-pull output stage.

Another point against single-ended voltage amplifier stages is that if the amplifier is resistance-capacity coupled, as it almost invariably is, the chief property of a push-pull stage, namely the ability to cancel out even harmonics, is not made use of. Some people have difficulty in seeing that this is so, but it is not difficult when we remember that the cancellation of second harmonic output in a push-pull stage depends entirely on the action of the output transformer. In this component, the second harmonic generated by one output valve is out of phase with that generated by the other, and so if the valves are matched, and each make the same amount of 2nd harmonic output, the nett result is none at all, since for second harmonic, the output of the valves cancel out. Suppose we have a push-pull output stage, fed from a push-pull resistance-coupled driver stage. The valves in the latter stage will certainly produce some second harmonic, even if it is only small in amplitude. This is passed on to the output valves without modification, because there is no connection of any sort between the individual valves of the driver stage. But if the driver's 2nd harmonic distortion is balanced, too (i.e. the driver valves each produce the same amount) this distortion will also be cancelled out, BUT ONLY AFTER IT HAS BEEN AMPLIFIED BY THE OUTPUT STAGE, AND WHEN IT APPEARS IN THE OUTPUT TRANSFORMER'S PRIMARY CIRCUIT.

From this, it would seem clear that unless the push-pull driver stage is very well balanced, just like the output stage, there will be very little advantage in it, from the distortion point of view. Its real advantage is not that it is push-pull, but that each driver valve is feeding only one output valve, and so is working with a smaller signal than it would otherwise have to handle.

For instance, take the well-known old arrangement in which a pair of 2A3s was driven by a 6C5 or 6J5 phase inverter, of the kind which has equal load resistors in plate and cathode circuits. This valve has to produce two signals for the 2A3s, each of approximately 50 volts peak amplitude. It can do this without distortion, only if it is provided with an H.T. supply voltage of 300 or more, but owing to the negative feedback inherent in such a stage, distortion is quite small, provided overload has not been reached. In front of the phase inverter it was usual to have a 6J7 voltage amplifier. Now this stage had to produce an undistorted signal voltage of about 63 volts peak, and this it was only just able to do, with a bit of a squeeze, so that there must be appreciable distortion arising in the voltage amplifier.

Suppose now that we decide to retain the same tube types, and to convert the stage to all-push-pull operation. One way of doing this would be to use a 6SN7, (which is exactly the same thing as two 6J5s) or bring in another 6J5, and make a push-pull driver stage for the 2A3s. Now these triodes are able to produce considerably more un-

distorted output voltage for a given H.T. supply voltage, than is the 6J7, so that the first advantage will be that the distortion generated by the driver valves will be considerably less than that of the 6J7 voltage amplifier of the other arrangement. The second advantage will be that such second harmonic distortion as is produced by the drivers (and since they are triodes, almost all their distortion is second harmonic) will, provided they are nicely balanced, be cancelled out in the output transformer. Thus, although we have dealt with two minor sources of distortion, their total effect is not necessarily negligible by any means, and we will have effected an improvement in the amplifier. Now the push-pull driver stage will have a gain of some 14 times per valve, so that the driving voltage needed at their grids is 50/14 = 3.6 volts, peak. Now this is too large an input voltage requirement for most purposes, so that an additional amplifier stage will be needed. If we want a high-gain amplifier, all we have to do now is to get a second 6J7, and use the two as a push-pull voltage amplifier stage. With a gain of

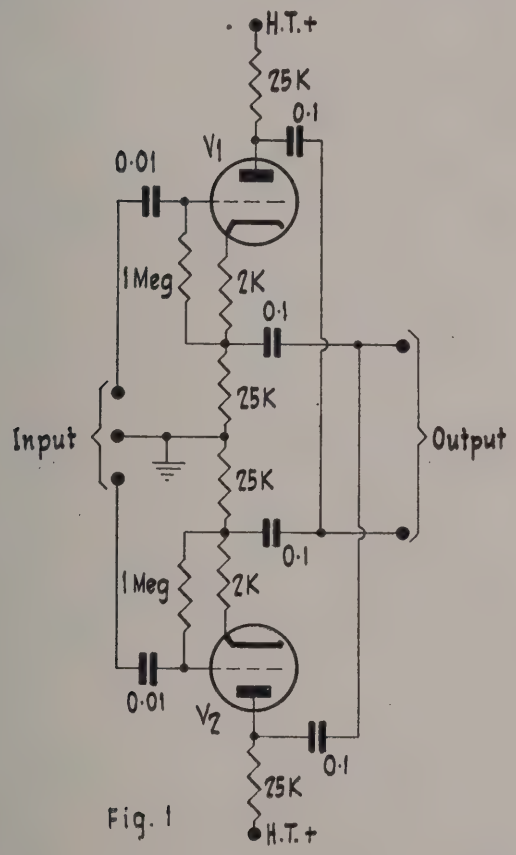


Fig. 1

100 times, the amplifier would fully load from a signal of 3.6 millivolts peak into each input valve, or a signal between the two input grids of 7.2 millivolts.

Of course, this order of sensitivity is not always needed, and in addition, we have the problems in an all push-pull amplifier of (1) providing volume control (2) providing balanced input signals, and (3) ensuring that both sides of the whole amplifier are well balanced. This last requirement means that the valves as well as all the components associated with them shall have equal characteristics, in pairs, so that both halves of the amplifier, from the input terminals up to the output transformer primary, will have an equal gain, distortion, and frequency response. If we can overcome all these problems, the design of a practical all-push-pull amplifier will have conferred all the advantages of decreased overall distortion. It is noteworthy that Williamson, in his famous amplifier went part of the way towards the all-push-pull amplifier by using a push-pull driver stage. There is the final question, having achieved all this, of ensuring that it is possible to provide equal and out-of-phase input signals from either a gramophone pick-up or a radio tuner, so that the need for a phase inverter will be eliminated. Luckily, however, this can be done, as earlier articles have shown.

PROPER BALANCE

Although the term push-pull is a well-known and convenient one, it is a little doubtful whether it should be applied to the sort of amplifier we have been discussing, except when we are talking about the output stage itself. A true push-pull stage includes an output transformer, where the balancing out of even harmonics, and the effect of the D.C. plate currents on the transformer core, take place, so that the whole arrangement should preferably be called a balanced amplifier rather than a push-pull one. This term emphasizes the importance of securing and maintaining proper balance between the halves of the amplifier.

This can be done by using a circuit which we introduced to readers in our March 1954 issue, and which we have re-drawn here in Fig 1. This arrangement has the property of automatically ensuring that even if the signals fed into its input terminals are not properly balanced, those emerging from the output terminals are. So good a balancing stage is it that even if a signal is fed into one side, and nothing at all is fed to the other, the outputs will be found to be almost balanced.

Accordingly, it can be used as a very effective balancing stage, for the purpose of correcting unbalances that exist in a previous stage. For example, suppose we have a high-gain balanced voltage amplifier using a pair of 6J7s. We may feed perfectly well balanced signals into the grids of this stage, but owing to differences between valves, either when new, or because they have aged differently after a deal of use, the signals at the output of the stage may not be at all well balanced. If these signals were fed directly to the grids of the output stage, some of the advantages of the push-pull connection would be lost, as we have already explained. But if we insert one of these balancing stages between the 6J7s and the output stage, any unbalance in the 6J7 outputs will automatically be corrected, and the output stage will still be supplied with balanced signal inputs.

The complete circuit of the all-push-pull amplifier is shown in Fig. 2. We should point out at the beginning that while readers can regard this arrangement as a thoroughly worked-out and tested one, which in fact it is, it is also very flexible design, to which many modifications could be made, according

to taste. For example, we have shown KT61s, triode-connected, in the output stage. There is no reason, though why the same tubes should not be tetrode connected, or why different tubes altogether, such as 6V6s, 6L6s, KT66s, EL33s, EL41s, EL37s, or any of the multitude of available output tubes should not be used, either triode or tetrode-connected. There is one proviso, of course, and that is that certain circuit values are altered to suit the valves chosen. About the only change necessary would be in the cathode bias resistor, and in the feedback resistors, not forgetting, of course, that different tubes need different loading for the best results. In this connection, it may be mentioned that the output matching shown on the diagram is that most suited to triode-connected KT61s. For a medium-powered job, these can hardly be bettered, as they will deliver 6 watts of audio for a power supply of 350 volts at some 80 ma.

The stage preceding the ouput stage employs the circuit of Fig. 1, exactly. There is really no difference in the circuit values, because we have now merely substituted the preferred resistor values, which we have now adopted as standard for our own circuits. The valve is shown as a 6SN7, but here again there is no reason why any available double triode should not be used, provided a suitable change is made in the bias resistor. For any tube which has resistance-coupled conditions published in the valve data books, the correct bias resistor can be found by looking up the conditions for a plate load resistor of 50k. This is NOT a mistake. It is a general rule that if the load resistance is split up between the plate and cathode circuits, as is done here, the correct bias resistor is the one given for a plate load resistance which is equal to the sum of the plate and cathode load resistors in the actual circuit, provided that as here, the grid leak is returned to the junction of the cathode load resistor and the bias resistor, and not directly to earth. Thus, the conditions when a 50k load resistor is used will give the correct bias resistor for the valve chosen. Other suitable valves would be any of the Philips-Mullard double triodes (provided they have separate cathodes for the sections) or such American types as the 6SL7. Of course, there is nothing to stop anyone from using separate triodes either, if they wish to. This would considerably extend the range of types available.

The gain of the balance-correcting stage is approximately 0.9 times from input to output on each side.

VOLTAGE AMPLIFICATION

The next requirement is for a voltage amplifier stage, since the balancing stage gives a small loss in place of gain. Here we have shown 6J7s, with plate load resistors of 100k. This gives them a gain of rather more than the data book says. This quotes a gain of 94 times when the following grid resistor is 0.5 Megohms. In the present arrangement, however, the input impedance of the balancing stage is more like 10 Megohms, on account of the cathode follower connection, so that the gain of the 6J7 stage will probably be about 110 times, thus counter-balancing the slight loss in the balancing stage. This stage is quite conventional, and includes unbypassed 47 ohms resistors in the cathode circuits, for the purpose of applying negative feedback, if this is required. If it is not intended to apply negative feedback, these resistors can be omitted. With the overall gain from the grids of the 6J7s to the output grids, of approximately 100 times, the amplifier would load fully from a signal of 0.09 volts. This is still rather more sensitive than is sometimes needed, and so leaves room for the gain reduction due to feedback, should this be wanted. With the valve line-up shown, and with the circuit values on the diagram, the reduction in gain due to feedback was approximately 5 times. This gives 0.45 volts peak signal for full output of the amplifier, and at the same time reduces the amplifier's already small distortion by a factor of 5. Thus, with well balanced output tubes, and a good output transformer, the total distortion should be of the order of 0.5%.

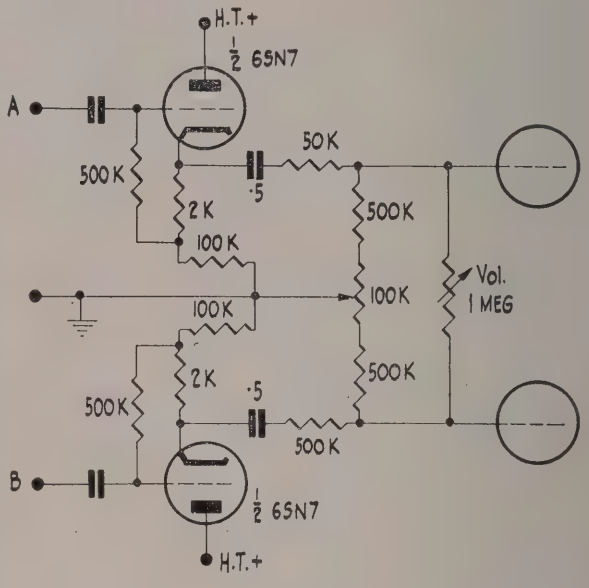
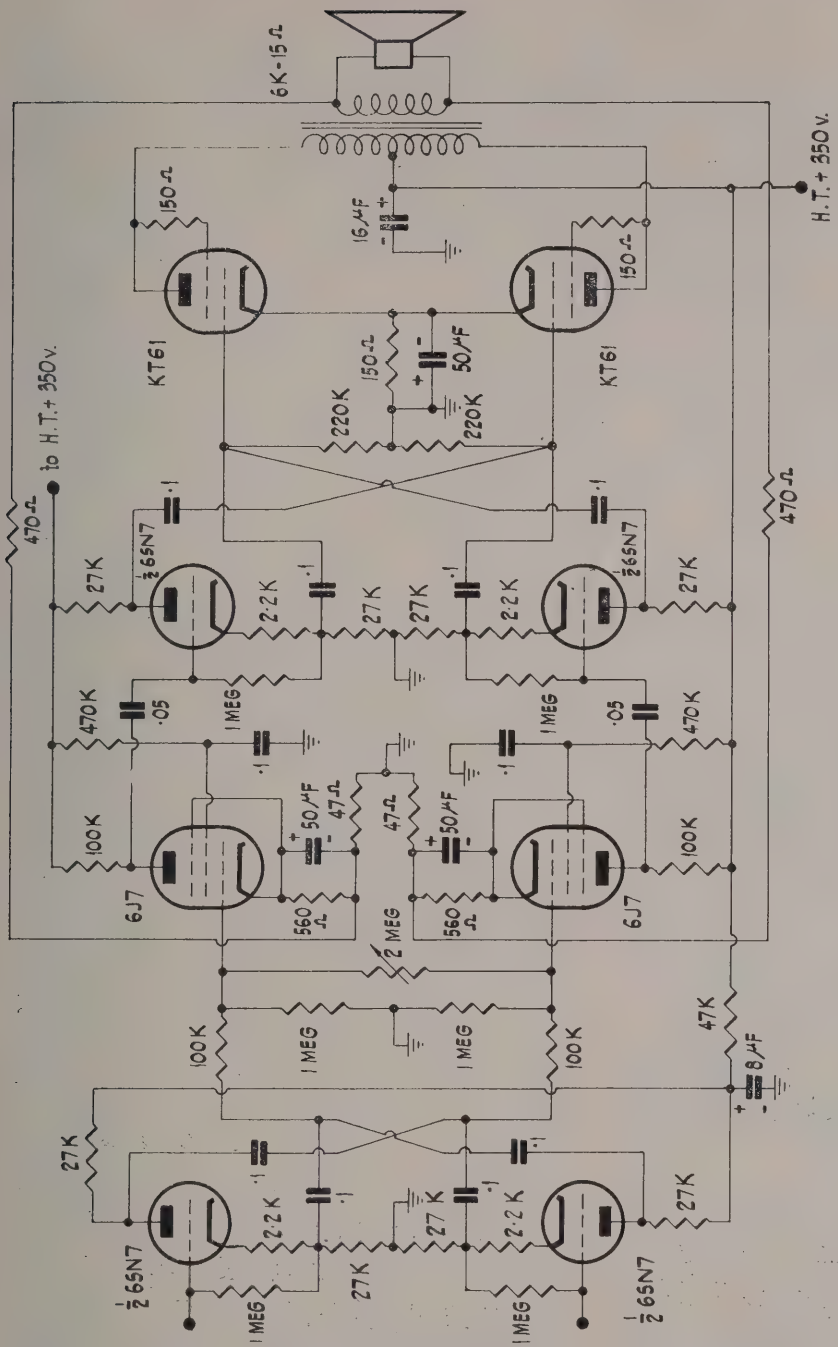


Fig. 3.

VOLUME CONTROL

In an earlier issue, reference was made to a means of obtaining volume control without the use of ganged potentiometers. This circuit is reprinted here as Fig. 3. It consists of a pair of cathode followers, feeding a network in which the volume control is connected from grid to grid of the following stage. Series resistors of 50k. are shown, and their function is to prevent the output of the cathode-follower stage from being short-circuited when the volume control is at minimum, i.e. with the grids short-circuited.

The purpose of the cathode followers is purely to isolate the volume control network from the input source. If, for example, the signal source were a crystal pick-up, or even a high-impedance magnetic, the A.C. load on it would be exceedingly variable, ranging from over 1 Megohm at full volume, to 100k. at low volume. This sort of thing could not be tolerated, because the resistance which shunts a pick-up affects its frequency response, so that the latter would then vary with the setting of the volume control in an undesirable way. However, interposing the cathode followers ensures that a very high impedance is always connected across the pick-up—much higher than the load recommended by the maker. It then becomes possible to shunt the cor-



rect load resistance across the pick-up, with the knowledge that the very high input impedance of the amplifier will have no unpredictable effects on the frequency response.

Now if we examine the main circuit, we will find that the special input stage, instead of being a pair of cathode followers, is a repeat of the circuit of Fig. 1. This can be regarded as a piece of low cunning, because the difference between the two circuits is only the addition of the plate load resistors and the cross-coupling condensers. Yet, for the addition of these components, we have gained a second self-balancing stage, without altering the essential buffer action mentioned above.

This last trick gives us the peculiar faculty of being able to feed either a balanced signal into the input grids, or to feed a single-ended signal into one of them. Whichever way we do it, the two self-balancing stages see to it that the output stage is furnished with perfectly balanced input signals! Naturally, the best way is to use balanced input, but this behaviour shows that we do not need to be very concerned about the accuracy of balance of the input signals.

There is even a third possibility. It is to feed two different signal sources into the two input terminals, and obtain mixing as well as balanced operation. Of course, the volume control in this case would work equally on both signals, so that their relative strengths would have to be organized by means of input level controls if it were also desired to alter their intensities with respect to each other.

FEEDING IN A RADIO TUNER

For feeding in a radio tuner's output, two things could be done. Either one could use the self-balancing feature by feeding in the output from a conventional single-ended detector to one input terminal, or else the detector circuit could be modified to give two balanced output voltages. This can be done by using the circuit of Fig. 4. Here, the detector load resistor is split into two equal parts, each with its own filter resistor and condensers. This diagram actually shows two ganged potentiometers used as an input volume control, but with this amplifier circuit, ganged pots would be unnecessary. Instead,

single-ended detector to one input terminal, or else the detector circuit could be modified to give two balanced output voltages. This can be done by using the circuit of Fig. 4. Here, the detector load resistor is split into two equal parts, each with its own filter resistor and condensers. This diagram actually shows two ganged potentiometers used as

Concluded on page 51)

WORKING A 1.4v. SET FROM THE CAR BATTERY

There must be numerous constructors who have built battery portables, and who would like to be able to run them from the car battery, or from the lighting battery in a caravan. This article describes how a vibrator-pack can be made that will operate the battery set without modification to the latter, except for adding the requisite power plug

INTRODUCTION

Until battery receivers using transistors become all the rage, (and they certainly will before very long) the operating cost of a battery-operated portable is quite high. A set of batteries is by no means an inexpensive item, with the result that many people do not use such sets at all, or, if they have one, they use it as little as possible, so as to conserve the precious batteries.

This is an unfortunate state of affairs, because the advantages of the battery set are very great, especially in the summer time. It is very nice, if one is on the beach, or watching a Plunket Shield cricket match, to be able to get the result of the next race, or to hear the commentary on the current Australia-England test match, but to do this entails the use of a battery portable, with its attendant disadvantages. At the moment, unfortunately, there is no way out of this dilemma, but various expedients have been proposed, or are in use, to mitigate the battery replacement nuisance. The best-known of these is the familiar A.C./battery portable. This enables the same set to be used either as a battery portable or as an A.C. operated set. Some of them even include a facility for "recharging" the dry batteries while the set is on A.C. operation.

This scheme works out very nicely, but has at least two disadvantages. The first cost is high, because of the duplication of power supply, and because of the special switching that must be included. In addition, such sets do not provide for operation from anything but the 230v. 50 c/sec. mains, and so are little use in a caravan. Some sets are made commercially which will run from all three types of supply, but needless to say, they are more expensive still, and they are limited to operation from 12 volt car batteries, on account of the 9 volt series filament arrangement that is used.

The device described in this article does not claim to do any more than one thing, namely provide a vibrator supply which will run any ordinary battery portable which has 1.4 volt parallel-connected filaments, from either a 6 or 12 volt accumulator. The facility for changing from 6 to 12 volts has not been provided, because we did not think that many people would want to do such a thing. However, a simple bit of switching could be incorporated if one wished, to do just this.

The original vibrator supply was built for a caravan owner who had had a battery set made for his vehicle, but who subsequently decided that the battery replacement costs were too high, and that it would be cheaper to have a vibrator supply made than to obtain an entirely new set.

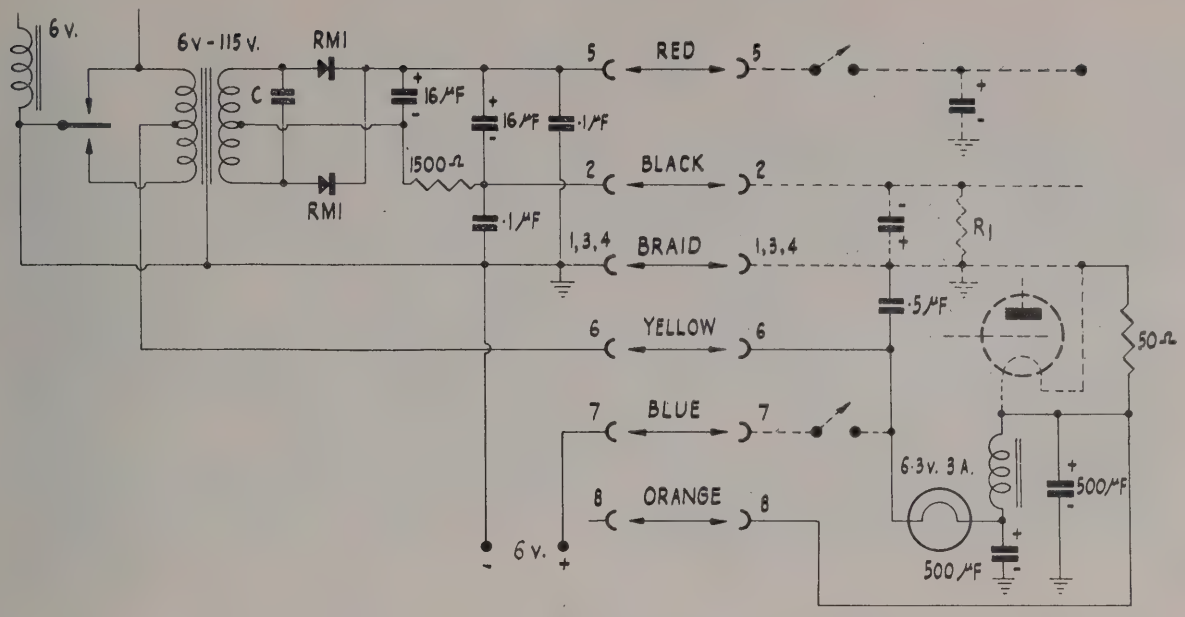
THE CIRCUIT

The vibrator unit is very simple indeed, as it contains only the vibrator, its transformer, and the very simple H.T. filter. The circuit diagram also includes, drawn dotted, some of the components in the receiver itself, so as to make the method of making connections clear. Also, it is necessary to place the smoothing circuit for the A supply inside the receiver itself, so that this part of the circuit is shown in full lines, on the right of the diagram. The cable and its terminations are indicated by the numbered pins on octal plugs and sockets and by the colour code indicated on the wires of the cable.

As drawn, the unit is wired for six-volt operation, and the modifications needed for 12 volt working are detailed in a later paragraph. A non-synchronous vibrator is used, together with two metal rectifiers, type RM1, in a conventional full-wave circuit. The transformer is a stock item, and will not have to be specially made for the job. Resistance-capacity filtering is used, and it will be seen that the negative side of the H.T. supply is NOT earthed. The reason for this is that practically all battery portables use back-bias for the output stage, so that B— is connected to the top of the back-bias resistor instead of to ground. This resistor is represented by R_1 in the diagram.

A surprising feature of the circuit is that it contains no chokes for hash filtering. The fairly large smoothing condensers, together with 0.1 bypasses from B leads to the chassis of the power unit, and the further 16 μf. electrolytic condenser across the H.T. line at the receiver, are all that is required to suppress all traces of vibrator hash.

The method used for supplying the parallel-connected 1.4 volt filaments is rather unusual, and requires some explanation. Basically, the idea is to drop the 6 or 12 volts to 1.4 by using dial lamps as dropping resistors. For a 6 volt supply, one 6.3v. 0.3 amp. dial lamp is used. Now on the face of it, this would produce too low a filament voltage for the set, but in practice, exactly the opposite occurred. The set concerned was a five-valve one, with the usual line-up of 50 ma. and 100 ma. filaments, so that the total was 300 ma. Now this is the rated current of the dial lamp, so that one would expect the addition of the resistance of the filament circuit in series with it to reduce the current, and so to give the filaments less than their rated voltage. Actually, what happens is that the smaller current through the lamp causes its resistance to be rather lower than the value it has when passing full current, and as a result, the voltage across the valve filament circuit is a little high. This effect is compensated by connecting a



small resistor across the filaments. This increases the current through the lamp, increasing its resistance, and lowering the filament voltage. Although the resistor is shown as 50 ohms in the circuit diagram, this will not necessarily be the correct value in a given instance, because of variations in dial lamps, and in the valve filaments. Its value should be adjusted by the user to give a measured 1.4 volts across the filament circuit when the accumulator voltage is exactly 6. This allows for the additional filament voltage that will result when the battery is fully charged.

Builders should take particular note of the filament smoothing circuit, which is installed inside the receiver itself. The choke is an iron-cored vibrator A choke, and is a standard item with at least one transformer manufacturer. If this filter is omitted, there will be a good deal of 100 c/sec. hum from the vibrator—much too much to be tolerated.

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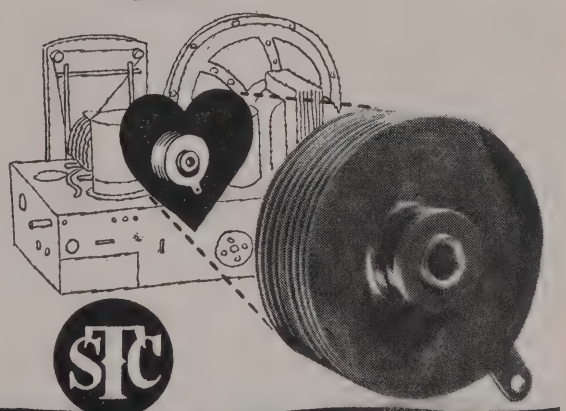

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NEW ZEALAND TO GET SUBSCRIPTION TELEVISION

Immediate introduction to New Zealand of a subscription television service is to be sought. This was announced in a joint statement by Commander Eugene F. McDonald, Jr., President of Zenith Radio Corporation, U.S.A., and Mr. A. L. C. Webb, Managing Director of Rola Company (Aust.) Pty. Ltd., and its New Zealand associate, Loudspeakers (N.Z.) Ltd.

Under the terms of the contract, Rola is to organize a new company which will be licensed under Zenith's Phonevision patents. This Company will immediately seek government and industry support for Phonevision. The contract grants the right to manufacture and use all transmitting and receiving apparatus necessary to the operation of the various Phonevision systems.

According to Zenith officials, the contract terms allow the broadest possible use of Zenith's many subscription television patents already filed in Australia and New Zealand. This will permit the new company maximum freedom to stay in the forefront of the developing TV picture in both countries. Although the patents cover different systems of Phonevision, it is anticipated that the Air Code System will be preferred over the systems using telephone lines.

Engineering representatives of Rola and Loudspeakers (N.Z.) Ltd. will go to Chicago shortly to undergo intensive training by Zenith Phonevision experts, and a Zenith crew will probably visit New Zealand at a later date to help set up Phonevision here.

Speaking for Zenith, Commander McDonald stated that: "Now that we have negotiated this first contract for its use, we expect rapid expansion of our systems of subscription television. We are well advanced in negotiations with other countries. It gives me great pleasure that our associate in this first foreign development should be the Rola Company, an organization prominently established in the manufacture and sale of radio equipment in Australia and New Zealand. We feel that they are excellently equipped to undertake the successful introduction of Phonevision in their territory."

Speaking for his organization, Mr. Webb stated: "The contract with Zenith opens a new field for us. The Australian Royal Commission on Television has urged that immediate steps be taken to encourage the creation of programmes that will set acceptable cultural standards also that the best use should be made of local talent. Phonevision will make television broadcasting in Australia and New Zealand commercially profitable and culturally outstanding without danger of overcommercialization. Neither advertising nor government sponsorship has been able to provide an adequate solution to the serious problem of television costs in countries which now have it. Phonevision seems to me an ideal way of solving the same kind of problem which we can be expected to encounter in both Australia and New Zealand.

"With the introduction of Phonevision, it will be economically practical to bring television to many rural areas and sparsely settled localities."

Mr. Webb said that his company had studied different systems of subscription television for more than a year before committing itself to the systems developed by Zenith. It was his conclusion that the development of a reliable system demanded vast research ability and a willingness to make substantial financial outlay. He said that his company decided to enter into an agreement with Zenith when it became convinced of the technical and commercial superiority of Phonevision systems. "There is no doubt in my mind that Zenith has established a position of leadership in this field," he stated.

Mr. Webb also declared that "from a long range viewpoint, the real significance of subscription television is not confined to its effect on television broadcasting. It could have a profound effect on all segments of the Australian and New Zealand entertainment industry by opening a new and lucrative maket for high quality entertainment."

* * * *

Brief Technical Description of Phonevision

Phonevision is a method of providing television entertainment for a fee, and will enable television broadcast stations to offer high quality programmes too expensive for either government or advertisers' sponsorship.

In order to restrict the programme to those who subscribe to the service, Phonevision broadcasts are scrambled or mixed up in such a way that both the sight and sound programmes are unintelligible before they are decoded.

The decoding information is supplied to the Phonevision subscribers who pay a fee for this service.

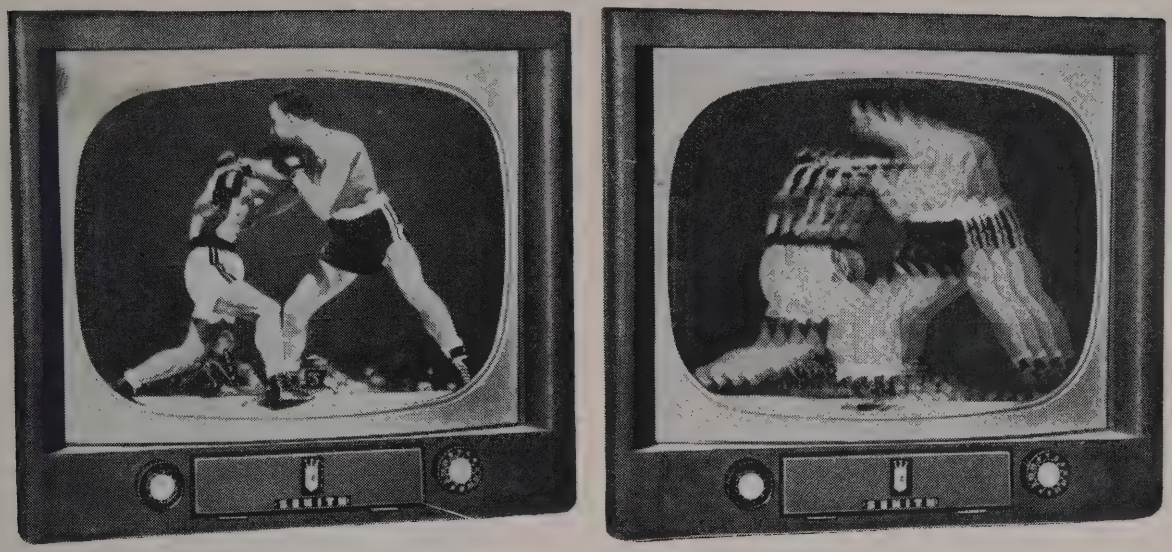
In Phonevision, two types of information are needed before a subscriber can "unscramble" the picture and sound. The first type called "key **signal**" is transmitted over the air along with the programme. The second type of information called "key **number**" is mailed or issued directly to subscribers in advance of the broadcasting of a Phonevision programme.

Originally, Phonevision used telephone lines to convey the "key **signal**" to subscribers but a more advanced method known as the Phonevision Air Code system has been developed. In this system, the key signal is coded and is broadcast simultaneously with the Phonevision programme.

The "key **number**" supplied directly to subscribers, after being dialled on a Phonevision attachment connected with the television receiver, permits the "key signal" to become operative, thus effecting the unscrambling of both picture and sound.

Programme "key numbers" are individual to each subscriber and it is impossible for two subscribers to share the information.

Commercially, therefore, the operation is a matter of distributing the appropriate "key number" to subscribers, for which Phonevision has developed a very flexible system of operation, permitting various methods of "key number" distribution.



Showing the appearance of the television picture before and after "unscrambling" by means of the code signals.

MARINE RADIO OFFICERS

Contrary to general public opinion there is an unlimited field for young men, who are prepared to devote their time and study to become qualified as Radio Operators, in the Merchant Marine Service. Ever since the end of World War II shipping companies have had difficulty in obtaining qualified radio personnel. The Marconi Marine Radio Co. alone requires an annual intake of over 200 Radio Officers.

Radio Operator's Certificates, which are officially known as P.M.Gs. Certificates, are of two classes. 1st Class and 2nd Class. The 2nd Class Certificate, however, is of limited value in itself, except that it must be obtained as the first step in the examination for the 1st. Class Certificate. In addition to the morse operating, the theoretical and practical knowledge required is the same as for a 1st Class Certificate in Radio-Technology.

A candidate for a Radio Operators Certificate should be of British parentage or be naturalized; have passed their 18th birthday when sitting the examination, and be able to produce an educational certificate of Form 2 or higher. Examinations in New Zealand are conducted twice yearly. The average time required to obtain a 1st Class Certificate is 15 months full-time study, or about 2 years at night classes or by correspondence.

Radio Officers on ships registered in New Zealand commence on £48 a month, all found, with annual service increases. They rank as Officers on the ship; dining in the saloon on passenger ships; or in the officers' mess on cargo vessels. The work is easy and interesting; with plenty of free time in port. For those interested in travel, photography, or writing it offers an ideal opportunity for assimilating knowledge and collecting material. A Radio Operator being also a qualified Radio Technician, is not limited to a lifetime at sea. The Broadcasting Service, Civil Aviation, Post and Telegraph Department, and other technical radio fields are open to him ashore.

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DEMONSTRATION OF R.C.A. TELEVISION EQUIPMENT IN DUNEDIN

Television was seen again in Dunedin at the 1954 Industries Fair, held in the Dunedin Town Hall, early in October. This was the first of three demonstrations of modern American equipment given by Messrs. Amalgamated Wireless (Australasia) Ltd. in the course of a three weeks' visit to the southern city. Later, the same equipment was used to demonstrate the possibilities of TV for teaching purposes at the Dunedin Public Hospital, and finally for a one-day advertising programme in one of the city's largest department stores.

Transmitting and camera equipment used in these demonstrations was remarkable for its compactness. Intended essentially for industrial applications, the "TV Eye," as the equipment is known, is manufactured by R.C.A. in the United States of America, and comprises a light-weight camera and small control unit. In effect, the camera and control unit constitute a diminutive TV transmitter capable of feeding any standard American TV receiver operating on the American standard of 525 lines at distances up to 2,000 feet on a closed circuit.

A verichrome film exposed at 1/25th second requires the same illumination on the subject for a satisfactory picture as the "TV Eye." One-hundred-foot candles of incident light are sufficient to bring this sensitivity within the range of the 2 in. f1.5 lens supplied with the camera.

At the Industries Fair, six receivers, placed in the main Town Hall and Concert Chamber, enabled visitors to the Exhibition to watch performances televised from the Town Hall stage. Included in the original plans for the Exhibition was a television studio, but this project was later abandoned and all televising was done from two "TV Eye" cameras directly on the stage. Long cables from cameras to a central control booth at the foot of the stage and moveable tripods were used in order that the cameras might be moved readily about the stage. Here the picture was monitored and controlled on a receiver above the booth, and communication between cameramen and control engineer was maintained with headsets and microphones.

The cameras, intended primarily for fixed focus applications in industrial situations, had to be modified with the addition of a small monitor C.R.T. in order to televise stage shows successfully. From the small picture at his camera, the operator could maintain correct focus, field of view and lens opening as the occasion demanded, and either of the cameras could be switched at the control point to the six display receivers.

All the lighting equipment readily available served only to produce 50 ft. candles of incident light over the large area of the Town Hall stage, with patches of much smaller intensity. Satisfactory pictures of wide scenes were difficult to produce under these conditions, but for subjects in a smaller area, it was possible to concentrate several 500 watt photoflood lamps in reflectors, and close-ups of announcers and demonstrations at a table were well reproduced.

During the course of the Exhibition, a wide variety of programmes was televised, including ballet sequences, commercial demonstrations of food-mixers, cosmetics, houshold appliances, and also mannequin parades of clothing and millinery.

The "TV Telephone," as demonstrated at Dunedin.

Capable of operation in the region of 54-88 mc/s., the camera oscillators were tuned to the lowest frequency channel available (55.25 mc/s.) to reduce R.F. attenuation losses in the coxial cables and shielded transmission lines to the receiver antenna terminals.

TVI (Television Interference) is a problem which has long been recognized in countries where an established TV service is operated. From its very nature, it was to be expected that an Industries Fair, with many exhibits of heavy electrical machinery, would contribute its share of interference, and the pictures did, in fact, suffer to some extent. Fortunately, a battery of electric sewing machines scarcely ten feet from the control position was fitted with TV suppressors as standard equipment, and thus did not cause much trouble. An interesting source of interference came from beats between the two cameras themselves. With all the receivers tuned to channel 2 (55.25 mc/s,), it was necessary for both cameras to be aligned on the same channel, and very disconcerting horizontal, oblique or vertical black bars appeared across the picture as the beat frequency between the two oscillators changed from zero to the order of 1 mc/s. These undesirable beats, and also a certain amount of cross modulation between cameras, were the result of using what, in effect, were two transmitters in very close proximity. By switching the H.T. supply to the oscillator of the camera not in use, it was possible to eliminate the beats while still maintaining a picture for monitoring. The cross modulation was eliminated by very careful arrangement of earthing grids at the R.F. switching point between cameras.

An interesting addition to the demonstrations at the Industries Fair was the TV Telephone, which, using the same cameras as for stage televising, was operated when there were no stage performances.

Two telephone booths equipped with conventional desk type telephones were situated at each side of the Hall, so that a person speaking in either booth could see the person to whom he was speaking on a TV screen in front of him. At the termination of conversation, the replacing of the telephone handset in its cradle cut off the picture by switching the beam current in the camera pick-up tube.

Although we doubt whether the Dunedin Post Office was beseiged with requests for such a service, the demonstration aroused considerable interest—especially among the younger members of the city's population.

An indication of one of the more serious uses for TV was given when the equipment was demonstrated at the Dunedin Public Hospital. The usefulness of TV for teaching purposes in this field has long been recognized, as it is possible for a large number of student doctors to have an unobstructed view of the magnified image of an operation performed in a theatre in some other part of the building.

The "TV Eye" equipment is ideally suited for this application, and, with the small camera mounted centrally on the 500 watt surgical light, excellent pictures of the operation performed were obtained. The control unit and one monitoring receiver were tucked unobtrusively in a corner of the operating theatre used, and did not interfere with the normal theatre routine. From here the picture was wired to a darkened lecture hall where two receivers enabled up to 100 students to watch the operation clearly. No additional lighting in the operating theatre was necessary, as the surgical operating light provided adequate illumination of more than 500 foot candles on the scene.

One difficulty experienced here, however, was the interference caused by diathermy apparatus used to reduce bleeding from small arteries. Black and white horizontal patterns obliterated the picture, but the receivers remained synchronized, and a clear picture was available immediately use of the diathermy ceased.

Senior surgeons and dentists expressed pleasure in the quality of the results obtained, and, on only one point—that of reproduction in colour—did they seek improvement. For the rendering of fine anatomical details, colour would be advantageous, but, alas, the cost, size and complexity of the apparatus would be many times greater.

At the conclusion of the demonstrations at the Dunedin Public Hospital, the equipment was transferred to the D.I.C. department store. Six receivers were distributed through the store, including one in a street window, and various merchandising programmes for home appliances, cosmetics, shoes, clothes, etc., were continued throughout the day. Although primitive by comparison with normal film scanning arrangements, a 16 mm. film was televised successfully by projecting it on a transparent ground glass screen and focussing the camera lens on this image. A discrepancy in the ratio of frame frequency of the receivers at 25 per second and projection frame speed at 24 per second caused a pulsating fluctuation in brilliance, but this could be eliminated by running the projector slightly faster at 25 frames per second.

One extremely pleasing feature of the equipment used throughout these demonstrations in Dunedin was the degree of stability of which it was capable. After a short warm up period, a synchronized picture could be maintained throughout the evening. Probably, this is due in part to the very adequate ventilation of both camera and control unit, and the low operating voltages and power consumption of the equipment.

It must be admitted that perhaps some Dunedin audiences were not as impressed by these entertainment demonstrations are they might have been No doubt, this reaction, not confined to Dunedin, is due to the glowing reports of TV overseas, and to the extremely high quality of reproduction in all other forms of modern entertainment. However, from a small 17 in. screen almost lost in the vastness of a brilliantly lit auditorium, one can hardly expect the best effect from an entertainment medium designed for the comfort of one's own home. The latter will be the true testing ground when TV eventually comes to New Zealand.

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The PHILIPS Experimenter

An advertisement of Philips Electrical Industries of N.Z., Ltd.

No. 87: PHILIPS TRANSISTORS (Part 2)

Reprints of these EXPERIMENTER articles, complete with illustrations, will be mailed to any address for one year for a subscription of 5s. Application should be made to Technical Publications Department, Philips Electrical Industries of New Zealand Ltd., P.O. Box 2097, Wellington.

In the first instalment of this series of Experimenter articles, we had something to say about Philips transistors in general, and point-contact transistors in particular, with a very brief and elementary description of how they are operated. This month we go on to describe the junction transistor and its applications.

TRANSISTOR LIMITATIONS

It may come as a surprise to some readers that transistors, and particularly point-contact types, have certain limitations, which at the moment at least, make their job as a competitor for ordinary valves a more difficult one. In the first place, they are rather noisier than valves. That is to say, if we made a high-gain amplifier from point contact transistors, and another from valves, and tried them out on the same low-level microphone, we would find that the transistor amplifier would produce somthing like ten to twenty times as much noise as the valve amplifier. This is unfortunate, because it limits rather severely, the use of point-contact transistors as audio amplifier stages, and but for the introduction of the junction transistor, transistor hearing-aid amplifiers, to cite only one example, would not yet be with us.

The inherent noise of the point-contact transistor would also make itself much noticed were we to make such a thing as a transistorized communications receiver. Indeed, it is very noticeable even when we make a transistor version of the regenerative detector, so here we have a very serious limitation to the use of transistors, at least of the point-contact kind. Fortunately, the junction transistor is much less noisy than its forerunner, and with it, high-gain audio amplifiers can be made that are very little noisier than valve amplifiers, so that for this sort of application, the day is saved.

Another disadvantage of point-contact types is the difficulty of making them with reproducible characteristics. That is to say, it is much more difficult than it is with valves to make large quantities of point-contact transistors so that their electrical characteristics all correspond closely. This question of sameness of characteristics is one which we take very much for granted with valves. So much so, that when we are working out new applications, or new circuits, we tend to take entirely for granted the published curves of the valve we are interested in, assuming that every valve which carries the same type number will have exactly these characteristics They won't, of course, but that we can make such an assumtpion and get away with it is really a striking tribute to the valve maker's skill. So far, though, all attempts to make point-contact transistors conform exactly to a standard set of performance curves as well as valves have failed, in spite of all the care and skill that Philips and other renowned makers have lavished on the problem. We are not at the moment in a position to say just why it is so, but after further articles in this series, we think the reasons should become self evident. Junction types, however, can be made in a much more reproducible manner, and are thus so much the more easy to apply to mass-produced circuits, whose characteristics must not vary by more than a given amount if the device is to be a commercial success.

The third inherent limitation of transistors at the present time is that of frequency response. We all know that present-day valves are made so that they will function at frequencies up to about 1000 mc/sec. (in special cases) and that quite ordinary valves will work at tens, and even hundreds of megacycles per second without our having to take very special precautions. With transistors, however, the situation is very different. Many transistors are difficult to make work at all, at fequencies very little higher than the broadcast band, and so are quite useless even at moderately high frequencies. It is true that special types are made (at great cost) which will work up to 50 mc/sec. or so, and that experimental ones have been made to go much higher than this, but this limitation is perhaps the most serious one of all at the present time. Frequency-wise, point-contact types are in general superior to junction types, many of which are useful only at audio and low radio frequencies. However, means for overcoming this particular drawback are rapidly being developed, and the next few years will see a very different picture presented to would-be transistor users.

The last limitation we propose to mention here is that of power handling capacity. The general run of transistors available to-day is limited to a collector dissipation (which corresponds to plate dissipation in a valve) of 100 milliwatts or so, which means that large power outputs, such as valves will easily deliver, are not at present obtainable from transistors. Here again, though, research is catching up, and recently a 20-watt transistor was reported to be in production for defence purposes. High-powered transistors can also be expected to be commonplace in the not very distant future, and when this is so, valves will feel their competition much more keenly.

JUNCTION TRANSISTORS

Now all this sounds like a very sad story, and anyone not in the know might be forgiven for assuming that compared with valves, transistors are almost useless. In point of fact, nothing could be farther from the truth, and it is these very limitations that are causing so much development work to be done, and many new things to be discovered

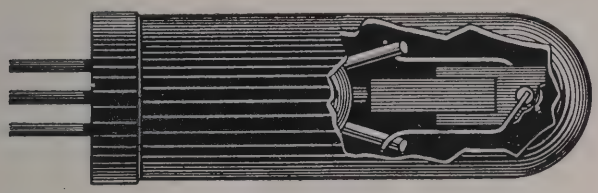


Fig.—1. Cut-away view of a Philips Junction Transistor.

about transistors. For example, the junction transistor was developed partly on theoretical grounds, and partly in an attempt to find the answer to some of the above difficulties. It is several years younger than the point-contact type, but already it looks like the answer to many difficulties, and research laboratories everywhere are giving it top priority in their development programmes. It derives its name from the fact that it contains no points, instead, its charatcteristics are based on the properties of a physical junction between two different types of Germanium. It is found that when these two types are brought into contact, the junction between them exhibits all the properties of a point diode. That is to say, such a junction acts as a rectifier. Now, if a sandwich is made in which a very thin layer of one type of germanium is held between two pieces of the other type, we have three electrodes once more, and the whole thing shows amplifying properties, just as does the point-contact transistor.

One way of making a suitable junction is as follows, A single crystal of p-type germanium (just what this means we shall see later) is "grown" by a special process, which produces a rod-like lump of solid metal of the p variety. This rod is then transferred to a bath of n-type germanium, where a thin layer is grown on. The crystal is then removed, and a further layer of p type germanium grown on over the layer of n-type. This process produces the sandwich referred to, and this is then cut into small slices, and leads are put on, one to each layer, giving the completed junction transistor. The central layer is the base, while the outer layers act as the emitter and collector, just like the points in the point-contact type of transistor.

This brief description is enough to indicate that the junction transistor contains nothing which is critical of adjustment, such as the spacing between points, which are liable to shift after the timing has been put together. The characteristics depend (a) on the composition of the materials, and (b) on the size and thickness of the layers in the sandwich. Although all these things are most difficult to control accurately, the junction transistor, once made, is obviously much more likely to "stay put" in its characteristics. In addition, once the manufacturing techniques have been worked out, making reproducible units is only a matter of accurate control of the processes, which is a much less hit-and-miss affair than attempting to control the size, spacing, etc. of point-contacts. The interior construction of a Philips junction transistor is illustrated in Fig. 1, which is obviously greatly enlarged, since the transistor itself is only just over half an inch long.

TRANSISTOR CIRCUITS

Just as it is possible to connect valves in a number of different ways, so it is possible to do the same thing with transistors. An excellent introduction to the use of transistors is to examine the different basic types of transistor circuit, and to compare these with the corresponding valve arrangement.

The three basic methods of transistor connection are:—

(1) Grounded emitter,
(2) Grounded base, and
(3) Grounded collector.

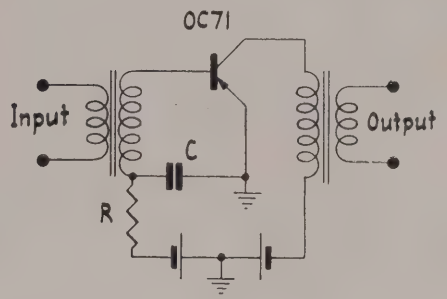


Fig.—2.

The first of these corresponds broadly with the ordinary grounded-cathode method of connecting a valve, and the circuit is shown schematically in Fig. 2. In order to make the circuit more easily "translatable" for those who are used to dealing with valve circuits, we have shown the circuit as a transformer-coupled one, with separate supplies for the base and collector electrodes. Here, it will be seen that we have a negative supply for the collector, and also a negative one for the base. Readers of Part 1 of this series will remember that the collector is always biased in the "non-conducting" direction, while the

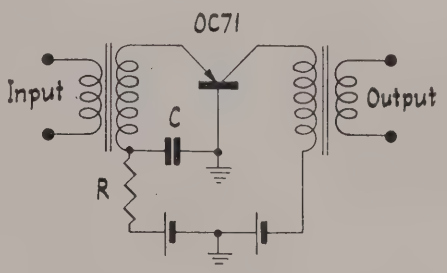
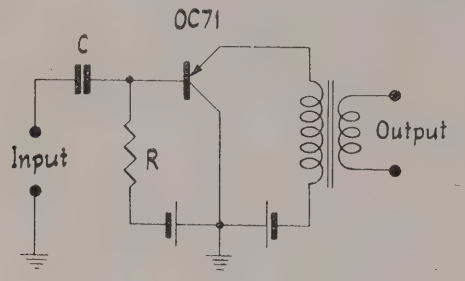


Fig.—3.

emitted is biased in the forward, or conducting direction, Thus, as the emitter is earthed, a negative supply voltage applied to the base makes the emitter positive with respect to the base, and thus fulfils the above condition. The resistor-condenser combination RC is simply a decoupling network, while at the same time R limits the emitter current to the required value. Notice that with transistors we almost

always talk about bias **currents**, where with valves we talk about bias voltages. When an input signal is applied to the circuit, through the transformer, the negative half-cycle increases the potential between the base and the emitter, thus increasing the emitter current. This in turn increases the collector current, and since the current flows in the direction of the arrow, the collector voltage becomes less negative This is the same thing as saying that the voltage at the collector rises, so that by this we can see that the grounded-emitter circuit produces phase inversion, just as does the grounded cathode connection of a valve .



In the input circuit of a valve, used as a Class A amplifier, the grid does not draw current, and the input impedance is very high. With the transistor, on the other hand, the situation is reversed. The emitter circuit draws current all the time, and the input impedance is low. For that reason, transistors are ideally suited to working from low-impedance pick-ups or microphones, without the intervention of a coupling transformer, and if they are required to work out of a high-impedance source, a step-down coupling transformer must be used. In a transistor, the output impedance is always much higher than the input impedance, which is once more exactly the opposite of a triode valve, and also explains why inter-stage transformers in transistor amplifiers are always step-down affairs. Step-down ratios of the order of five or ten to one are the most frequently used.

Fig. 3 shows a transistor in a grounded-base circuit, also with transformer coupling. This time, the only difference is the reversal of the emitter supply battery, so that the necessary positive bias current is still applied. Now, however, a positive-going input signal gives a positive-going output signal, so that there is no phase reversal. In this respect, the circuit behaves rather like a grounded-grid valve stage. The similarity is further heightened by the fact that the grounded-grid valve circuit, like the transistor one, has a low input impedance, and a much higher output impedance.

The third and final type of connection is shown in Fig. 4. Here, the input is again applied to the base, but the collector is grounded, and the output is taken from the emitter. This sounds, and works, too, rather in the same manner as a cathode follower. Its output impedance is very low, and its input impedance is very high (for a transistor circuit, making it rather suitable for impedance-matching circuits). For example, it would be an excellent one to use as a buffer stage between a valve circuit and a transistor one. This arrangement also gives no phase reversal of the signal.

In the course of these articles we shall have examples of all these types of transistor connection, as they are used in practical circuits. Although the actual circuits of Figs. 2, 3, and 4 would work, they are seldom used exactly in this form. It is possible, and always done in practice, to run any of them from only one battery, and it is here that the extreme simplicity of transistor circuits starts to be complicated somewhat. Most of the commonly used arrangements, however, have their counterparts in valve practice. For instance, in the grounded emitter circuit, one method of applying bias without using the left-hand battery is to insert a bypassed resistor in the lead between emitter and earth. This corresponds very closely to cathode bias in a valve circuit.

(To be continued).

N.Z.A.R.T. NOTES

From an amateur's viewpoint, 1954 can be regarded as a successful year. Technically, the most outstanding happenings were the transistor transmissions from ZY4GP and the steady upsurge of activity in the U.H.F. regions. These activities have done much to restore amateur radio to its original and true place in the radio world—the quest for development and the continuous search for something new. That the day of the true experimenter is fading is evident by the arrays of commercially made equipment to be seen in many ham shacks of today.

N.Z.A.R.T. has secured the long awaited approval for the use of specified foreign languages. Although, at the time of writing the necessary Gazette notice has not been published, this should not be long.

A new scheme of reporting has been mooted by I.A.R.U., and while the R.S.T. system will not change as far as telegraphy is concerned, if the new proposal is approved by member societies, it will provide a system for telephony which will give an indication of the modulation quality.

Throughout 1954 Official Observer Stations have functioned and helped set many amateurs on the right track. However, these Stations still seem to be regarded somewhat apathetically, some amateurs considering it a stigma to request assistance. We therefore emphasize that these stations are NOT policemen. They are there to help. We feel that many would avail themselves of assistance, but are afraid of being regarded as inferiors if they ask for help on such a widely tuned band as 80 metres. Every amateur has been in trouble at some stage in his ham life, and, in the "good old days," no one was too ashamed to request assistance. So let it be now—and in 1956.

Talking of the "good old days," another of the dying arts seems to be that of "QSL'ing." Over recent years the once final courtesy of the "QSO" has fallen into disuse. A new "Q" signal even made a brief and unofficial appearance—"QSLL"—which meant, "I will QSL when I get your card." When both stations in contact adopt this attitude, a stalemate occurs. Cards cost only a very small percentage of the annual upkeep costs of an amateur station, so let us all start 1955 with a new outlook on the "QSL" situation. N.Z.A.R.T. operates its own Bureau under the guidance of ZL2LB, Bill Fouhy, and he will be only too glad to see the cards come rolling in.

For the first time the new system of our Council election will operate this year. The regional basis will ensure a more even distribution of Councillors, and should enable members to feel that at least one member of Council will always be reasonably handy.

The Christchurch Conference at Queen's Birthday week-end will celebrate the Silver Anniversary of the Association. Plans are in hand already to make this 1955 Conference well worth attending.

October and November showed that conditions are improving and the VK/ZL and CQ/DX contests were well patronized. Forty metres produced a few surprises, and Europeans were quite consistent in the early evening. The DX is there, but it seems that a contest is needed to really bring it up!

TUBE DATA

THE EL84 NOVAL-BASED OUTPUT PENTODE

(Information by courtesy of Philips Electrical Industries of N.Z. Ltd.)

The EL84 is a new audio output pentode of high efficiency, especially suited to applications where more power output is required than can be obtained from conventional output tubes. With a 250 volt H.T. supply, a single EL84 will deliver 6 watts into a load of 5200 ohms, with a total H.T. drain (plate and screen) of 61 ma.

In Class AB_1, with plate and screen voltage of 300, and a load of 8000 ohms plate-to-plate, a power output of 17 watts is obtainable. Under these conditions, the no-signal H.T. current is 80 ma., rising to 114 ma. at full output. With 250 volts on plates and screens, 11 watts can be obtained, for a no-signal current of 69 ma., which rises to 90 ma. at full output.

These figures are remarkable for a tube of the small physical size of the EL84, which uses a nine-pin Noval base. The valve is particularly suited to use in high-quality feedback amplifiers of medium power output, and to low-powered modulator stages. Both sets of figures quoted above are for use with cathode bias, and as the current swing is quite small, these conditions offer no particular difficulty in practice, as conventional power supplies with reasonably good regulation may be used.

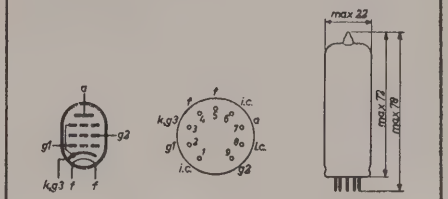
With fixed bias, two EL84s can be used in Class B_1 (i.e. without grid current) to give 11 and 17 watts output with H.T. supplies of 250 and 300 volts respectively. Under these conditions, the plate efficiency is considerably greater than with self-

OUTPUT PENTODE

Heating: indirect by A.C. or D.C.; parallel supply

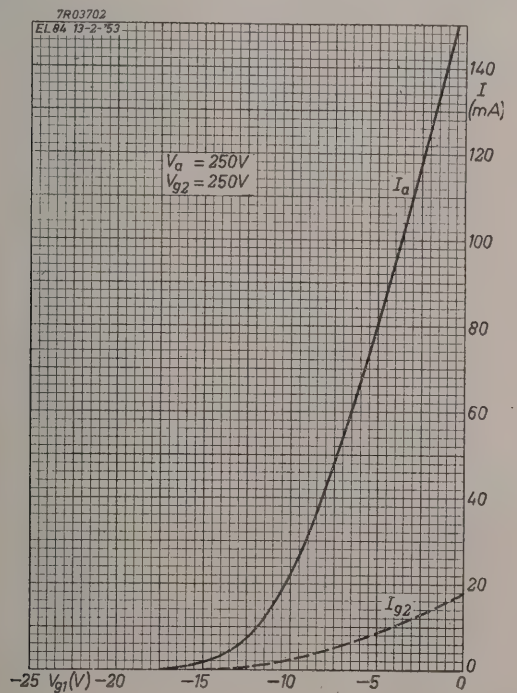
V_f = 6,3 A
I_f = 0,76 A

Dimensions in mm



Capacitances

C_{g1} = 11 pF
C_a = 6 pF
C_{ag1} < 0,5 pF
C_{g1f} < 0,25 pF



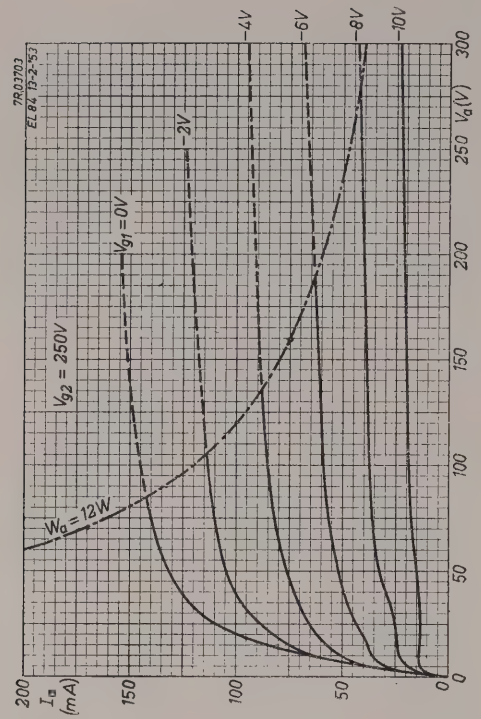
Limiting values

V_{ao}	= max.	550 V
V_a	= max.	300 V [1]
W_a	= max.	12 W [1]
V_{g2o}	= max.	550 V
V_{g2}	= max.	300 V [1]
W_{g2}	= max.	2 W
W_{g2p}	= max.	4 W
$-V_{g1}$	= max.	100 V
$-V_{g1}(I_{g1}=+0,3\mu A)$	= max.	1,3 V
I_k	= max.	65 mA
R_{g1}	= max.	1 MΩ [2]
R_{g1}	= max.	0,3 MΩ [3]
V_{kf}	= max.	100 V

[1] When the heater and positive voltages are obtained from a storage battery by means of a vibrator, the max. values of V_a and V_{g2} are 250 V and that of W_a is 9 W.

[2] With automatic grid bias

[3] With fixed bias



biased Class AB1 operation, as the quiescent H.T. currents are 21 ma. and 16.5 ma. for 250v. and 300v. operation respectively. However, power supply regulation must be better than for Class AB, because the maximum currents, at full output are 90 ma. and 104 ma. respectively for the voltages quoted. If the quoted power outputs are to be realized in practice, regulation of the screen voltage is highly recommended, and users should remember that the output powers quoted in the valve sheets take no account of the losses in the output transformer. Thus, actual power output at the secondary of the output or modulation transformer will be less than the given figures by 20 to 30%, depending on the transformer efficiency.

Tabulated data and characteristics curves are reproduced on this and the previous page.

Operating characteristics class A

V_a	=		250			V
V_{g2}	=		250			V
V_{g1}	=		-7,3			V
R_k	=		135			Ω
R_a	=		5,2			kΩ
V_i	=	0	0,3	3,4	4,3	4,7 [2] Veff
I_a	=	48	-	-	49,5	49,2 mA
I_{g2}	=	5,5	-	-	10,8	11,6 mA
S	=	11,3	-	-	-	- mA/V
R_i	=	38	-	-	-	- kΩ
μ_{g2g1}	=	19	-	-	-	-
W_o [1]	=	0	0,05	4,5	5,7	6,0 W
d_{tot} [1]	=	-	-	6,8	10	- %
d_2 [1]	=	-	-	3,0	2,0	- %
d_3 [1]	=	-	-	5,8	9,5	- %
V_a	=		250			V
V_{g2}	=		250			V
V_{g1}	=		-7,3			V
R_k	=		135			Ω
R_a	=		4,5			kΩ
V_i	=	0	0,3	3,5	4,4	4,8 [2] Veff
I_a	=	48	-	-	50,6	50,5 mA
I_{g2}	=	5,5	-	-	10	11 mA
S	=	11,3	-	-	-	- mA/V
R_i	=	38	-	-	-	- kΩ
μ_{g2g1}	=	19	-	-	-	-
W_o [1]	=	0	0,05	4,5	5,7	6,0 W
d_{tot} [1]	=	-	-	7,5	10	- %
d_2 [1]	=	-	-	5,7	5,0	- %
d_3 [1]	=	-	-	4,5	8	- %

[1] Measured with fixed bias

[2] I_{g1} = +0,3 μA

Operating characteristics class B, two tubes

V_a	=	250		300		V
V_{g2}	=	250		300		V
V_{g1}	=	-11,6		-14,7		V
R_{aa}	=	8		8		kΩ
V_i	=	0	8	0	10	Veff
I_a	=	2x10	2x37,5	2x7,5	2x46	mA
I_{g2}	=	2x1,1	2x7,5	2x0,8	2x11	mA
W_o	=	0	11	0	17	W
d_{tot}	=	-	3	-	4	%

Operating characteristics class AB, two tubes

V_a	=	250		300		V
V_{g2}	=	250		300		V
R_k	=	130		130		Ω
R_{aa}	=	8		8		kΩ
V_i	=	0	8	0	10	Veff
I_a	=	2x31	2x37,5	2x36	2x46	mA
I_{g2}	=	2x3,5	2x7,5	2x4	2x11	mA
W_o	=	0	11	0	17	W
d_{tot}	=	-	3	-	4	%

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RECORD TALK

By JOHN GRAY

Among the more interesting of the discs recently processed by H.M.V. have been two, the first to be made available here, by the famous New Zealand singer, Inia Te Wiata, who has been a member of the Covent Garden Opera during the last few years. Recorded in England but not thus far released there, the records feature four very familiar titles, "Pokarekare" and "Hine e Hine" on HR 39; "Home Little Maori home" and the inescapable "Waiata Poi" on HR 40. All are supported by chorus and orchestra, with some poi effects in the last named. These thoroughly Europeanized, melodious presentations can hardly be recommeded as true samples of Maori Music, perhaps, but they will please the vast majority of listeners and the singer, if not exactly another Oscar Natzka, has a fine, resonant voice of which we would willingly hear much more. H.M.V. are to be congratulated on their enterprise in letting us hear a celebrated New Zealander whose voice has become well known a long distance from his native land.

Two further H.M.V. discs introduce "The Stavemasters," described as New Zealand's leading harmonica ensemble (the time-honoured and, after all, accurate term "mouth organ" is seemingly discouraged nowadays). Their choice of numbers comprises "The Golden Wedding" and "Beer Barrel Polka" (HR 50) and "Song of India" coupled with "Answer Me" (HR 51), the vocalist in the latter being Shirley Williams.

Overseas hit parade material made available by the H.M.V. group includes Eddie Fisher's version of "My Friend" and "Green Years" (EA 4196) and Betty Madigan's version of the new and appealing ballad "Joey," which is backed by "And so I Walked Home" on M.G.M. 5180.

Another 10-inch disc (EA 4180) comes as an old and welcome friend. Most of those who were overseas during the war years will want it, as it is, I believe, the original version of "Lili Marlene." At least, the artist is Lale Anderson, the Swedish cabaret singer who first popularized the song. The backing is a number in a similar vein, "Three Red Roses." This is in many ways an important and perhaps historic issue, for "Lili Marlene" was practically the only popular song of World War II which became part of the lives of servicemen on both sides.

Tanza are drawing attention, justifiably, to their new vocal group, the "Three Lads," who have power and punch and are well backed up by their accompaniment. So far their most interesting disc is Z 238 which couples two catchy new numbers, "Sh-Boom" and the South African tune "Sokiaan," which has swept triumphantly to the front within the last month or so. The group are also heard in "Hit and Run Affair" (Z 232) which has as its backing Graham Godbeer's singing of "Green Years." And on another new Tanza (Z236) Pat McMinn puts considerable vitality into a new favourite "This Ole House," and an old one, "Oceana Roll."

On Capitol, Al Martino, who first came into prominence two years ago with "Here in my Heart," has by now adopted a more restrained vocal style. An attractive ditty called "Give me something to go with the wine" has an Italian flavour, and shares CP 332 with another swinging melody entitled "On and On."

* * * *

Radio Corporation have also announced a small shipment of imported Capitol LP records, wisely catering for all shades of musical taste. On the lighter side are such favourite entertainers as Nat "King" Cole (CL 012) the Milt Herth Trio (CLP 011) and Billy May (CLP 004) while followers of the more up-to-date tendencies in jazz will plump for Stan Kenton on CLP 026. The disc on which Claude Rains narrates "The Story of Jesus" (CLC 007) should find a ready welcome here. Among the "Capitol Classics" which have also been made available are two worthy of special attention, as there are no competitive versions, but not only because of that. One is the "Five Tudor Portraits" by Vaughan Williams, a vigorous setting of poems by the early English writer, John Skelton. Recorded at a recent International Contemporary Music Festival at Pittsburgh, this features a full throated chorus and soloists with the Pittsburgh Symphony Orchestra conducted by William Steinberg. The disc was made during a public performance and so one can hardly hope to identify all the words all the time, but the full text is provided on the jacket, and all lovers of English choral music should warm to this work, boisterous and tender by turns. In fact it is definitely not just music for "specialists" for Vaughan Williams is at his most masterly and most lovable in this setting. One of the poems, "Jane Scroop, her lament for Phillip Sparrow," contains some of the most touching music this composer ever wrote. The number of the record is CLC 017.

The other "out of the way" disc contains "Romeo and Juliet," by Tchaikovsky; not the famous overture, but a vocal duet closely connected to it since it utilizes many of the same themes. It seems to have been written for an opera which never materialized as such, and it is well rendered by two splendid young singers, Jean Fenn and Stephen Manton, with the Los Angeles Orchestral Society under Franz Waxman. The record (CLC 012) contains also another duet, this time from Gounod's "Romeo and Juliet," an opera which was better known in Melba's day than it is in ours.

Also in this group of Capitol releases are a fine performance of Cesar Franck's Symphony by the St. Louis Symphony Orchestra under Vladimir Golschmann (CLC 018) and Faure's "Requiem" in which the choir is the famous Roger Wagner Chorale, on CLC 023.

Besides having put out a consolidated catalogue listing all their releases, the Festival people have come forth with another crop of interesting new discs. Admirers of Les Paul will be interested in CFR 10–405 which stems from the time when he was better known as the leader of the "Les Paul Trio," and those novelty instrumentalists the Pinetoppers have a disc which has been called "Song Parade," CFR 10–415. Many people will welcome Leroy Anderson's "Irish Suite" which the composer directs on CFR 10–431. Anderson has composed some of the few instrumental tunes to attain hit parade status during the last few years, and there is nothing he doesn't know about effective arranging of orchestral material. That grand old veteran of show business, Sophie Tucker, may be heard growling her way through some of her most celebrated numbers on CFR 10–498.

On the classical side, a Westminster disc by the young Viennese pianist Paul Badura Skoda features a Mozart programme played on a piano which was built about 1785, thus ensuring that we hear the music practically as Mozart's hearers did (WL 5153). Badura Skoda has recorded the same programme on a modern piano, and it is reasonable to assume that Festival will also make that disc available for purposes of comparison. Two melodious concertos by Vivaldi are played by the violinist Peter Rybar with the Vienna Symphony Orchestra on WL 5006.

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Effect of Inverse Feedback on Input Impedance—II

By J. B. EARNSHAW

In the case of voltage feedback, circuit 7 provides a good example. The feedback voltage is obtained from the anode circuit via the network Z_1, Z_2. If we concern ourselves with the mid-frequency region of response of the circuit (see 7c), we can arrange that $1/C_2\omega$ is much greater than R_2 so that C_2 is effectively a short circuit. R is present purely to provide a D.C. path from grid to earth and if R is much greater than $R_2/(1 + A)$ then its presence can be neglected.

Using the notation of diagram 7c(E) the current flowing through . . .

$R_1 + R_2$ is equal to

$$i = \frac{e - e_o}{R_1 + R_2} \qquad \text{..... (6)}$$

and substituting $e_o = Ae_g$, we have

$$i = \frac{e + Ae_g}{R_1 + R_2}$$

The voltage applied between the grid and cathode $e_g = e - R_1 i$, therefore

$$e_g = e - \frac{R_1}{R_1 + R_2}(e + Ae_g)$$

rearranging $\quad e_g(R_1 + \dfrac{R_2}{1 + A}) = e(\dfrac{R_2}{1 + A})$

and since $e_o = -Ae_g$

$$e_o = -e \cdot \frac{AR_2/(1 + A)}{R_1 + R_2/(1 + A)} \qquad \text{..... (7)}$$

. . . and the stage gain is

$$-e_o/e = \frac{AR_2/(1 + A)}{R_1 + R_2/(1 + A)} \qquad \text{..... (8)}$$

The current flowing into the input terminals in this case is defined by equation (6), and the reciprocal of the input impedance $1/Z_{in}$ is:

$$\frac{i}{e} = \frac{1 - e_o/e}{R_1 + R_2}$$

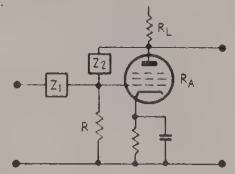
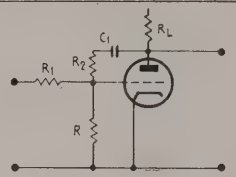
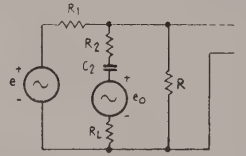
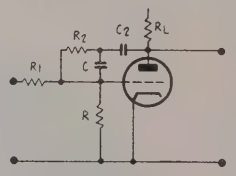
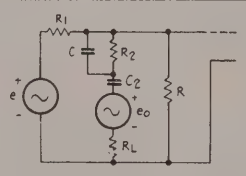
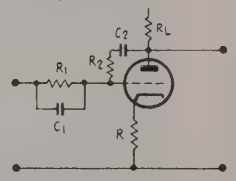
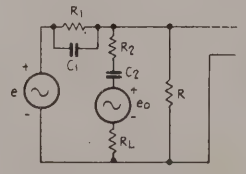
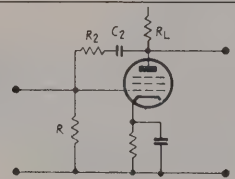
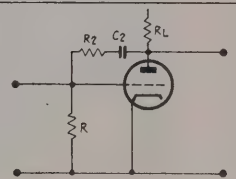
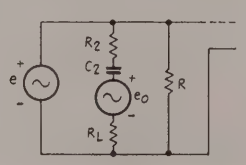
and substituting for e_o/e from equation (8)

$$\frac{i}{e} = \frac{1}{R_1 + R_2}\left\{1 + \frac{AR_2}{R_2 + (1 + A).R_1}\right\}$$

which tends towards $\quad \dfrac{1}{R_1 + R_2/1 + A}$

The input is therefore $R_1 + R_2/1 + A$ (9)

PAGE 3

	A	B	C	D
7(c)				i) $R_1 + R_2 \gg R_L$ ii) $\frac{R_2}{R_1} \ll gR_L$ iii) $R_2 \gg \frac{1}{C_2\omega}$ iv) $R \gg \frac{R_2}{1+A}$
7(d)	High Frequency Cut			i) $R_1 + R_2 \gg R_L$ ii) $\frac{R_2}{R_1} \ll gR_L$ iii) $R_2 C_2 \gg R_2 C$ iv) gain falls by 6db/octave above $f = \frac{1}{2\pi R_2 C}$ v) $R \gg Z_2/(1+A)$
7(e)	High Frequency Boost			i) $R_1 + R_2 \gg R_L$ ii) $\frac{R_2}{R_1} \ll gR_L$ iii) $R_2 C_2 \gg R_1 C_1$ iv) gain rises by 6db/octave above $f = \frac{1}{2\pi R_1 C_1}$ v) $R \gg Z_2/(1+A)$
8				i) $R_2 \gg R_L$ ii) $R \gg Z_2/(1+A)$

This expression would indicate an equivalent circuit of two resistances R_1 and $R_2/1 + A$ in series. Diagram 7c (F) represents exactly this and provides a stage gain of that shown by equation (8) when followed by an amplifier of gain A.

The circuit gains are in every case calculated for signal sources with zero output inpedances. However if the source has an output impedance Z_o, the circuit gains are then modified by the factor $Z_{in}/Z_o + Z_{in}$.

The method of developing equivalent circuits appears to have a strong theoretical basis and it can be extended to more complex circuits by analogy with some of the results presented.

Notes on circuite 7 (c) to 8.

(c) Over the mid-frequency region where Z_1 and Z_2 are entirely resistive, the gain and input impedance are constant.

(d) Decreasing gain input impedance characterize the high frequency response of circuit 7d. and it can be used to compensate for the high frequency pre-emphasis incorporated in L/P records.

(e) Compensation for the loss of high frequency response normally encountered in crystal pick-ups can be obtained by using the fifth variation of the circuit 7e. Z_1 decreases as the frequency rises consequently the stage gain Z_2/Z_1 increases, and is finally limited in the same manner as 7a. The turn-over frequency is $1/2\pi R_1 C_1$ and above this frequency the gain increases by 6 db/octave.

Frequency dependent networks using inductances instead of condensers may be employed and similar results are obtained.

Circuit 8. This circuit does not have many practical uses since it has a very low input impedance. However it serves to illustrate the fact that the grid-anode capacity is magnified by $(1 + A)$ causing a serious loss in the gain at very high frequencies.

The circuits given are by no means all the possible circuits employing inverse feedback, but by application of the method developed, the equivalent input circuit for any feedback system can be deduced either by comparison with the circuits shown, or by calculation along the lines indicated, thereby greatly simplifying subsequent circuit analysis.

The author would like to thank Dr. K. Kreielsheimer for reading the original manuscript.

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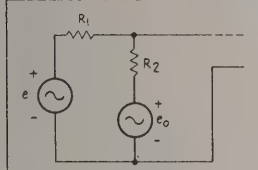
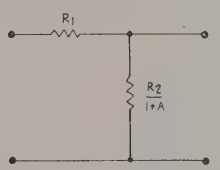
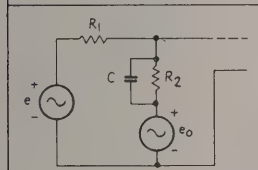
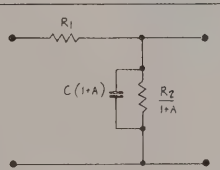
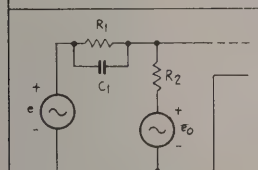
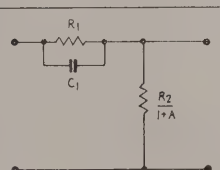
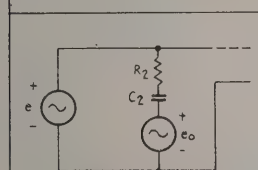
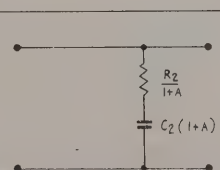
PAGE 4

(E)	(F)	(G)	(H)	(I)
		$A = gR_L$	$G = A.\dfrac{\frac{R_2}{1+A}}{R_1 + \frac{R_2}{1+A}} \doteq \dfrac{R_2}{R_1}$	$Z_{in} = R_1 + \dfrac{R_2}{1+A} \doteq R_1$
		$A = gR_L$	$G = A.\dfrac{R_2}{R_2+R_1(1+A)(1+j\omega C R_2)} \doteq \dfrac{R_2}{R_1(1+j\omega C R_2)} \doteq \dfrac{R_2}{R_1}\dfrac{1}{(1+\omega^2 C^2 R_2^2)^{\frac{1}{2}}}$	$Z_{in} = R_1 + \dfrac{R_2}{1+A}\left(\dfrac{1}{1+j\omega C R_2}\right) \doteq R_1 + \dfrac{R_2}{gR_L}\dfrac{1}{(1+j\omega C R_2)}$
		$A = gR_L$	$G = A.\dfrac{R_2}{R_2+(1+A)\left(\frac{1}{R_1}+j\omega C_1\right)^{-1}} \doteq R_2\left(\dfrac{1}{R_1}+j\omega C_1\right) \doteq \dfrac{R_2}{R_1}(1+\omega^2 C_1^2 R_1^2)^{\frac{1}{2}}$	$Z_{in} = \dfrac{R_1}{1+j\omega C_1 R_1} + \dfrac{R_2}{1+A} \doteq \dfrac{R_1}{1+j\omega C_1 R_1} + \dfrac{R_2}{gR_L}$
		$A = gR_L$	$G = A = gR_L$	$Z_{in} = \dfrac{R_2}{1+A} + \dfrac{1}{j\omega C_2(1+A)} \doteq \dfrac{R_2}{gR_L}\left(1+\dfrac{1}{j\omega C_2 R_2}\right)$

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QUICK SELLING . . . NATIONALLY ADVERTISED . . . GUARANTEED. Stock this range of Eutron Immersion Heaters and build up your profits! Thousands of satisfied users insist on Eutron—stockists throughout N.Z. are happy with Eutron because selling Eutron builds profits, builds customer goodwill.

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(Subsidiary of Nicholsons Holdings Ltd.)

316 GREAT NORTH ROAD, GREY LYNN, AUCKLAND, W.2.

ELECTRICAL AND TRADE SECTION

FLUORESCENT LIGHTING FOR THE SMALLER SHOP

(Reproduced by courtesy of General Electric Co. Ltd., England, from Osram Bulletin, Vol. 31, No. 3)

It is becoming increasingly evident that no shopkeeper today can afford to be without fluorescent lighting either for his windows or for the shop interior. The tremendous development of fluorescent lighting in shops is readily visible—one has only to walk or ride past any parade of shops, however small, to see an increasing number of retailers who have decided that the additional lighting obtainable from fluorescent tubes is an extremely effective method of attracting the public to their premises. This does not apply only to the large multiple organizations who long ago decided that fluorescent lighting was necessary and would quickly pay for itself, despite the high capital cost in the early days of the development.

The retail shop that is today relying on a standard of tungsten filament lighting set in the immediate pre-war days, is sadly lagging behind, and again one can see in any group of shops the relatively gloomy windows and uninviting interiors of shops whose owners have not yet realized the necessity for being up-to-date.

When fluorescent lighting began to appear in shop interiors there were two factors that tended to restrict its use. First, and probably the more important, was expense; and the second—colour.

Now it is admitted that to relight a shop, including the windows, is an expensive business, but certainly no more so than other changes that have to be made to a shop in order to keep it in line with its competitors. New facias, new window interiors, cash registers, improved flooring, counter display equipment—all these are costly, but the shop that does not keep up-to-date cannot expect to maintain its position as an efficient seller and displayer. If fluorescent lighting is initially expensive, then at least it has the great benefit of being more economical in running cost because so much more light can be obtained from a relatively small consumption of electricity.

These arguments have been put very clearly from time to time, and judging by the great number of shops that have changed, and are indeed in the process of changing to fluorescent lighting, it seems apparent that the capital cost is not so fundamental an obstacle as it was a few years ago.

With colour, of course, a tremendous stride has been made recently in regard to the colour appearance and colour rendering of fluorescent tubes. It is agreed that, when fluorescent tubes were available only in Daylight and Warm White colours, it was a brave shopkeeper who exposed his meat or tomatoes and other foods to a light so deficient in red. Today, this situation has changed very radically and probably there is no shop window or shop interior that cannot be adequately and pleasantly lighted with fluorescent tubes. In this respect the new Osram De-luxe Warm White tube with its most pleasing colour rendering properties, closely akin to those of tungsten filament lighting, is bound to be a very welcome addition to the range. Also a wide range of fittings is now available to cover the most critical demands for "something that looks pleasant in my shop."

An unfortunate aspect of the growth of shop window lighting is the number of installations in

which fluorescent tubes are misapplied. It might be thought that the advent of fluorescent lighting in this field would see the end of the bare tungsten lamp suspended by a length of dusty flex, but regrettably fluorescent tubes are to be seen used in the same way and what a waste of light and money! There are far too many examples of badly lighted shop windows. The practice of outlining windows with bare tubes is a great waste of good lighting; and although the fluorescent tube has a remarkably low surface of brightness, in many cases the amount of light available tends to prevent the prospective customer from viewing the goods in the window without being conscious all the time of glare from the exposed tubes.

Window displays are a very suitable subject for combined fluorescent and tungsten lighting. For such purposes spotlight reflector lamps enable effective results to be obtained in conjunction with tubes in fittings designed for window lighting. They can be used similarly for picking out special displays inside a shop where the general lighting is by means of fluorescent tubes.

A tremendous expansion is still possible in changing shops and shop windows from tungsten filament to fluorescent lighting. At the same time many shops which have fluorescent lighting already need the simple advice which can, at so little extra cost, turn their installation from something garish and uneconomic to a pleasantly lighted window and an inviting interior.

NEWS FROM GOVERNMENT DEPARTMENTS

NEW ZEALAND STANDARDS INSTITUTE GENERAL REQUIREMENTS FOR ELECTRICAL APPLIANCES AND ACCESSORIES

To afford the interests most directly affected a further opportunity for examination and comment before it is finally approved by the Standards Council for declaration by the Minister as a standard specification, a third draft for a proposed standard establishing general requirements for electrical appliances and accessories has been circulated by the Standards Institute.

This draft has been prepared by the Electrical Accessories and Appliances Committee of the organization and includes amendments agreed to in the light of the comments received on the two earlier drafts. It also incorporates much of the wording of the latest edition of the British Standard 816—Requirements for Electrical Appliances and Accessories. The first draft, circulated some time ago, dealt with test requirements and the second draft covered requirements relating to constructions and safety, in addition to the former test requirements.

Standard specifications have already been issued for a wide range of electrical appliances, including refrigerators, kettles and jugs, toasters, irons, water-heaters, radiators and cooking ranges. The specification now being circulated will apply to all electrical devices, other than electronic devices, which are not specifically covered by separate specifications and which are designed for use in A.C. or D.C. circuits in which the declared voltage between conductors exceeds 32 volts A.C. or 50 volts D.C. and does not exceed 660 volts. It will thus safeguard the quality and safety of all those miscellaneous items which are not otherwise dealt with.

ULTRA-SHORT-WAVE RADIO ACROSS COOK STRAIT

Research by the Department of Scientific and Industrial Research has been resumed on the transmission of ultra-short-radio-waves across Cook Strait.

Radio transmission on these very short wavelengths of a few centimetres are used extensively for relaying television programmes and for telephone links that may carry several hundred channels simultaneously. The fact that the transmission can be carried out in a narrow beam rather like that of a searchlight is a great advantage in reducing the power required and also, of course, in maintaining privacy of telephone conversation.

The fading of programmes from a distant radio station is familiar to everyone; it is caused by the signal arriving at the receiving aerials by two or more paths simultaneously. The variation in the relative lengths of the different paths gives rise to fading of their resultant when the two are combined in the receiving set. In ultra-short-wave communication, such "multi-path" transmission is a serious problem for two reasons. First the sea, and to a lesser extent the earth in general, is a good reflector of radio waves, so across such a stretch of water as Cook Strait there is a strong signal reaching the receiver by way of the sea as well as by the line of sight path. Secondly the wave paths are bent to a varying degree by the troposphere (the lowest few miles of the atmosphere with which everyone is familiar), and the amount of bending is continually changing with weather conditions, giving rise to a change in the length of wave paths. In the broadcast or short-wave bands (wavelengths between a few tens and a few hundreds of metres) the changes in path length over short distances have a negligible effect, but at centimetre wavelengths their effect is severe, and gives rise to fading of the signal at the receiver. On a radio link across Cook Strait if the wave reflected from the sea can be prevented from reaching the receiver a substantial reduction in the amount of fading should be achieved.

Last summer the Dominion Physical Laboratory of the Department of Scientific and Industrial Research conducted trials across Cook Strait between Colonial Knob (the 1500 ft. hill behind Porirua) and a point near Seddon in the South Island. The path was chosen so that sea reflections were normally prevented from reaching the receiver by an intervening ridge of land. However, tropospheric conditions were sometimes such as to bend the wave path so severely that the ridge was no longer effective, and deep fading occurred. The trials to be carried out this summer, using a wavelength of 9 centimetres, are to discover how to avoid this difficulty, and determine if a link on this wavelength can be made sufficiently free from fading to provide a satisfactory telephone or television relay link.

POST OFFICE

The value of Himatangi Radio to our external telecommunications service has been amply demonstrated over recent weeks. With cable faults in the Pacific, the Wellington-London high speed radio-telegraph circuit, transmitting out from Himatangi, has been on extended hours clearing traffic at 150 words a minute.

* * * *

Toll calls from ordinary public slot telephones are becoming increasingly commonplace as more public phones are modified for toll use. Extension of the system to new areas depends on getting ample toll circuits.

"R & E" TECHNICAL PHOTOGRAPHS

Copies of original designs produced in our laboratory and featured in these pages are available. Prices are: Size 6 in. x 4 in. 3s. 6d.; 8 x 6, 4s. 6d.; 10 x 8, 5s. 6d. Please remit cash with order to Radio and Electronics (N.Z.) Ltd., P.O. Box 8022, Wellington.

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Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.

BINDERS FOR "R. & E."

These are available to hold 12 issues—price 5s. 6d.

IMPORTANT NEWS TO THE N.Z. RADIO INDUSTRY

Radio (1936) Ltd. to Manufacture EKCO Radio and Television Equipment in New Zealand

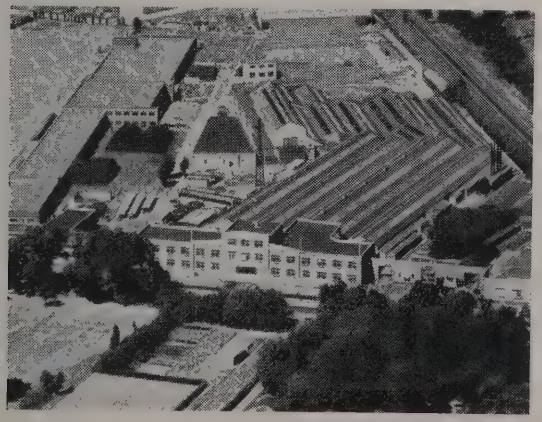
As we go to press comes the interesting and exciting news that, subject to normal formalities, Radio (1936) Ltd. is to undertake in N.Z. the manufacture of the famous EKCO radio and television equipment on behalf of Messrs. E. K. Cole Ltd. of Southend-on-Sea, Essex, England.

Originally a private retail company known as Radio Limited, Radio (1936) Ltd. commenced business in 1922. After ordering crystal sets from America, the Directors suddenly realized that there was no transmitting station in New Zealand to which these crystal sets could be tuned. Nothing daunted, they hurriedly cabled an order to the U.S.A. for a 500-watt transmitter. Through the wonderful co-operation of the U.S.A. authorities concerned, this transmitter was shipped on the same boat as the crystal sets. To Radio Limited, therefore, went the honour of erecting the first transmitter in Auckland, and the faults, failures and worries attached thereto form part of the story of the early development of radio in our country.

Progress was rapid, and in 1926, Radio Limited became registered wholesalers, trading in spares and bits and pieces, while the retail section of the business traded under the name of Super Radio Ltd. Before long, New Zealand's radio trade began to rely on the well-known importers, Radio Limited, who secured the Gilfillan Agency from Los Angeles. This was for three-valve, three-coil sets. They were imported packed in cases of twelve, and, so great was the demand, that, while still on the wharf, the cases were marked with the names of the buyers.

So limited seemed the field of radio in those days, that Radio Limited determined to take every advantage of this sudden demand for wireless sets before saturation point was achieved. In the light of the progress from 1927-1955, such early ideas of saturation point seem a little confined. In fact, now we wonder whether this can ever be reached!

Those early sets, of course, were battery operated. Then came the advent of the single-dial control,



Ekco Works, Southend-on-sea.

Mr. D. T. Clifton-Lewis, Managing Director of Radio (1936) Ltd. and Mr. N. C. Robertson, Deputy Managing Director of E.K. Cole Ltd.

still battery-operated. This, indeed, was a big advance, but right on its heels came the A.C. operated set. The latter comprised valves, permanent coils, and single dial for tuning, only the speaker being external.

Many were the developmental stages of speakers. First of all there was the horn type, operated by an over-large telephone earpiece to 18 in. cone speakers. Then came a great advance—the development of the Magnavox speaker. Following hard on its heels came the field energized speaker incorporated in the set cabinet, providing a self-contained unit in various sizes from the mantel or table model to the console or floor model. One of the most popular in N.Z. was that developed by the "Majestic" Company of America, which met strong competition from the various "Steinite" models offered by another American company. Indeed, the peak of perfection appeared to have been reached!

However, about this time, 1936, the New Zealand radio manufacturing industry was considerably assisted by the heavy import duty on English and American sets imposed by the Government in power. Finally, the importation of the latter was completely prohibited. This left the field open to the New Zealand radio manufacturers, but, in spite of the prohibition of overseas importations, competition between the New Zealand manufacturers was so fierce that the public continued to receive excellent value.

With the outbreak of war in 1939, however, radio manufacturing in this country ceased completely. Under the direction of a Radio Controller, the whole industry swung over to war work, and in this, Radio (1936) Ltd., by this time a public company, played its full share.

Peacetime production recommenced in 1945 after the cessation of hostilities. Since then, the Company has continued to expand, and today the turnover

figures for its manufacture of household and electrical appliances vie with those for its radio production.

The new agreement reached with Messrs. E .K. Cole Ltd., of Southend-on-Sea, Essex, England, comes as a direct result of the enterprise and development of Radio (1936) Ltd. On becoming minority shareholders of Radio (1936) Ltd., Messrs. E. K. Cole Ltd., through their New Zealand associate, are making available to the public of New Zealand the whole of the technical qualifications of their 350 or so laboratory employees.

Founded in 1922, the same year as Radio (1936) Ltd., the firm of EKCO was established by Mr. E. K. Cole as a small business for the manufacture of wireless sets. The latter were two-valve sets, complete with battery and headphones, sold for £6 10s., and production was at the rate of six a week. Several years later, Mr. Cole devised the H.T. eliminator to replace expensive and short-lived batteries. In 1925 a partnership was formed with Mr. W. S. Verrells, a customer who was very much impressed with this device, and the following year saw the establishment of a private company, E. K. Cole Ltd., to take over the partnership.

To accommodate the rapidly expanding business now employing between 50 and 100 workers, a factory was built at Leigh-on-Sea in 1927, but before long this was outgrown, and in 1930 the present factory at Southend was opened. This, too, has since been greatly expanded.

By this time, EKCO had commenced the use of plastic cabinets, imported because they were not available in Great Britain. 1931 saw the installation of moulding presses at Southend. Initially, these were intended to meet the Company's own internal requirements. However, so great proved the outside demands from many trades that the plastics department grew rapidly, and has now developed into a division offering a complete design, tooling and assembly service, which caters for the needs of the building, radio, photographic, domestic equipment, telephone and other industries.

By 1933 leading industrial designers were enlisted to style EKCO radio cabinets, and in 1934 entry into the field of auto radios was made to such good effect that, today, E. K. Cole Ltd. provides a very large proportion of all car radios fitted by British car manufacturers. Two years later saw the Company well ahead in the field of television development.

Within another twelve months, heating equipment had been added to the EKCO list of products. That year (1937) also saw the innovation of EKCO press-button motor tuning on domestic radio receivers, to be followed in 1938 with a low-priced add-on television unit—another development in which EKCO led the field.

Immediately after the outbreak of war, EKCO concentrated all its activity on military production. It was the first to produce the Mk. 1 A1 and Mk. 1 ASV equipment. That year also, the firm started its first shadow factory at Malmesbury in Wiltshire. By the following year production was dispersed to Malmesbury and to new factories at Aylesbury and Woking, with the Head Office at Aston Clinton. Plastics and lamp production, however, remained at Southend, and in 1941 the main radio assembly was restarted there.

By the end of the war, the firm had produced at Southend No. 19 tanks, prefabricated bomber wiring, radar valves, plastic practice bombs, gun flash simulators, and much other equipment. The Aylesbury factory units concentrated on aircraft radio and V.H.F. equipment, Malmesbury on radar equipment and specialized apparatus, Woking on pack sets, and another factory subsequently opened in Scotland at Rutherglen dealt with coil winding and sub-assemblies from 1944 onwards. At this time, the total number of employees was more than 7,000.

Mr. N. C. Robertson, C.M.G., M.B.E., Deputy Managing Director, Messrs. E. K. Cole Ltd.,

In 1945 the reconversion to peacetime production started with domestic radio production concentrated at Southend, where television output also commenced soon after. The Malmesbury factory continued with the manufacture of military pack sets, also developing radar apparatus and nucleonic equipment. Search radar equipment was developed for the Comet and other airliners.

The change-over rapidly gained momentum with the re-introduction of the EKCO car radio to many leading makes of cars in 1947, and, later that year, the installation of injection moulding plant in the Plastics Division. This last development presaged the situation today, when EKCO operates the largest compression and injection moulding presses in Britain. Recently, these have been supplemented by extruding machines.

1947 also saw the Canvey Island plant brought into operation, and another new factory was built there for the production of components and radios in 1951. The Hadleigh plant commenced operation in June, 1949.

1949 proved a memorable year, for it also saw the association of EKCO with the National Radio and Engineering Co. of India (a subsidiary of the vast TATA organization), resulting in the formation of National EKCO for the development and production in India of radio components and electronic devices. A similar arrangement—for the production of assemblies—has been concluded with an Eireann firm, Messrs. Kelly & Shiel Ltd., resulting in the formation of Kelly & Shiel (Ekco Products) Ltd.

Exports generally are many times the pre-war figures, a reflection of the experience gained about overseas conditions as a direct result of war work.

1953 welcomed another EKCO innovation—a new and inexpensive radar airfield landing aid, which pro-

(Concluded on Page 41.)

N.Z. Radio-Television and Electrical Trader's Association

For stimulus and interest, the recent social evening held by the N.Z. Radio-Television and Electrical Traders' Association in the Royal Empire Society Rooms, and attended by over seventy members and their wives, could not be bettered.

The main purpose of the gathering was the presentation of certificates to the 32 successful candidates who had completed the S.M.T.C. Course in TV servicing.

After congratulating the students, Mr. J. Malloy, deputizing for Mr. H. M. Scott, Principal of the College, paid warm tribute to the wonderful co-operation of the N.Z. Radio-TV and Electrical Traders' Association and to its individual members, thanking them for the financial support and the supply of various items of equipment. Such co-operation, together with a Government grant of £1,200, had established the S.M.T.C. laboratory as one of the finest in N.Z. for the training of TV students. Appreciative acknowledgement of the support accorded him from all quarters was also expressed by the tutor, Mr. Ron Waddell.

Surveying the difficulties and general progress of the radio industry since 1938, Mr. D. T. Clifton-Lewis of Radio (1936) Ltd. considered this to be one of the most enterprising of any of New Zealand's secondary industries. Now it is looking forward to the advent of TV. Then, these students, through their own foresight and endeavour, would find themselves in the vanguard of this exciting new development, and would be able to play on important part in the advancement of TV in N.Z. For this reason it was vital that they should continue their studies to keep abreast of world-wide developments in this sphere.

Fresh from an overseas tour, Mr. T. Spencer of Akrad Radio Corporation, gave an inspiring talk on the prospects of TV in N.Z., stating that, in his opinion, there was no reason whatever why TV should not be brought to this country almost immediately. Industry was geared to cope with it. The actual mode of TV transmissions was now more or less static, and the only possible change would be the introduction of colour, which he considered to be a very long way off. In fact, it was Mr. Spencer's contention that, even at this moment, it was within the bounds of possibility to give a daily TV service in N.Z. throughout the year. Subjects for TV programmes abounded, and the experience of many American stations proved that the most acceptable programmes were those of a simple and homely type. In addition, B.B.C. tape programmes are now available. Admittedly, the latter are somewhat expensive on account of the B.B.C. determination to maintain high programme standards, but the cost is more than justified by the excellence of the programmes. Though local N.Z. programmes might not achieve such perfection, nevertheless they could provide splendid entertainment, thus ensuring the continued expansion of TV in this country. The peculiar topography of Auckland lends itself to excellent TV transmissions, and, if only the Government would give the word, 400,000 people in and around the city could enjoy a TV service within two years. Nor would it be necessary for the Government to undertake its establishment, as private enterprise was ready and willing to make the service available. Indeed, according to Mr. Spencer, it was in the interests of New Zealanders that they should be given an opportunity to indicate whether or not a TV service was desired. In this field TV represents progress, and no Government is entitled to withhold the progress of any community.

(Continued from Page 40.)

mises to be of tremendous benefit, particularly to smaller airports.

During 1954 EKCO Electronics Ltd. was formed. This is a wholly owned subsidiary, which will assume responsibility for the marketing of electronic equipment, a sphere in which E. K. Cole Ltd. is steadily expanding.

Now, this vast store of knowledge, information, and experience will be of benefit to the public of New Zealand through that well-established firm of Radio (1936) Ltd., founded in the same year as its new associate, Messrs. E. K. Cole Ltd.

Such is the story of progress. In a country with an output limited to the needs of only 2,000,000 people, one firm has achieved pre-eminence. The other, catering for the needs of a population of of over 50,000,000, plus a valuable export market, as might be expected, has developed to a far greater extent. Now the combination of these two mighty forces must result in the public of New Zealand receiving the very latest and best of products for extremely modest prices. —P.B.A.

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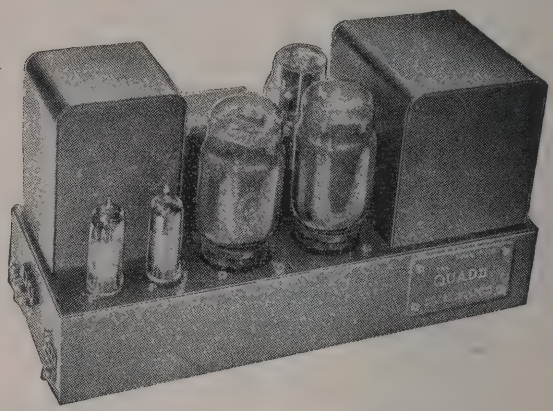

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NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars contact Advertising Manager, R. & E., Box 8022, Wellington.

ACOUSTICAL QUAD II AMPLIFIER

Now becoming available in New Zealand, the new model Quad II Amplifier is an outstanding example of British progress in this field. It is a leader, both in respect of circuitary, appearance and ease of operation. It employs push-button selection of recording characteristic compensation and of input selection. In addition to the standard compensations provided, the use of two or more push-buttons together will provide curves to take care of any unusual characteristic.

The output valves are the well-tried KT66 tetrodes used as pentodes with feed-back in the cathodes as well as in the plate circuit. The use of pentodes results in a plate circuit efficiency approaching 40%..

Normal power output rating is 15 watts at 0.1% distortion. The amplifier, however, can supply 20 watts at 0.5% distortion and the frequency range, plus or minus 0.5 DB, is 10 to 50 thousand cycles/second.

Another outstanding feature is the variable filter which can reach a maximum attenuation of 50 DB/octave and can start at 5, 7 or 10 thousand cycles. Hum level is minus 80DB, output impedance, either 7 or 15 ohms and the total weight is 25 lb.

Distributors throughout New Zealand are: Messrs. W. G. Leatham Ltd., 43 Taranaki Street, Wellington.

Missing and Stolen Radios

AUCKLAND:

Ariel Seven, 12 volt auto radio, baked hammertone mottled brown cabinet 9 in. x 8 in. x 5¼ in., eliptical 4 in. x 6 in. speaker, two control knobs, vibrator clamp has several scratch marks.

H.M.V. maroon portable radio.

A/A.R.T. French, 5-valve radio, (36 Rue Bery Toulouse Type 53), dark varnished wooden cabinet 20 in. x 10 in. with light varnished front, set-in dial with round map of world.

Rolls, 6-valve personal battery/portable, serial No. 164390, manufactured by Radio (1936) Ltd., cream plastic case.

HAMILTON:

Pacemaker, 7-valve auto radio, model 7150A, serial No. 22072 in two units—tuner in square box, power amplifier oval. Both units in hammer finish brown. Power amplifier unit has white moulded plastic grille. Units joined by § in. thick plastic covered (black) loom with 6 point female plug to fit male plug on back of tuner. Valve sockets have been rewired from a series 12 volt to a parallel 6 volt heater. Vibrator transformer also replaced. Repairs readily identifiable.

NEW PLYMOUTH:

Pacemaker, battery/electric, A.C./D.C. portable, serial No. 8166a, red plastic cabinet 15 in. x 12 in. x 9 in. with cream plastic handle on top.

WANGANUI:

Cromwell, mantel model, 6-valve broadcast radiogram, serial No. 14061, polished wooden cabinet 14 in. x 14 in. x 10 in., two control knobs and dial on sloping panel.

MARTON:

Bristol, 5-valve broadcast mantel model, serial No. 23354, white plastic cabinet 12 in. x 12 in., two control knobs, black oblong dial marked "Columbus."

WELLINGTON:

Cromwell "Little Jewel," serial No. 76614, green cabinet with white handle.

Columbus, 5-valve mantel radio, model 66W, serial No. 60197, wooden veneer cabinet.

Philips, 4-valve radio, serial No. 5879, royalty No. 78461, green plastic cabinet 10 in. x 6 in. x 4 in. with perforated hardboard cover on back. Two control knobs.

LOWER HUTT:

Autocrat car radio, model No. 6A0, serial No. 8570.
Mullard, model 454, serial No. 8897.

CHRISTCHURCH:

Pacific, 6-valve auto radio, serial No. 1989, cracked dial.
Army (War Assets) broadcast radio, khaki cabinet 15 in. x 15 in., round speaker and tuning buttons in front.

Philips portable, serial No. 9351, red cabinet 14 in. x 10 in., with no back, long dial at bottom front with white plastic surround, two white knobs.

DUNEDIN:

Six-valve Auto radio, serial No. 6645 in grey aluminium case with white tuning dial.

RADIOS RECOVERED:

Cromwell, model 7251, serial No. 7457.
Philips, model 126, serial No. 51893.

Performance of Loudspeakers

BRITISH STANDARD SPECIFICATIONS

From England comes the news of the issue by the British Standards Institution of a standard dealing with methods of "Ascertaining and expressing the performance of loudspeakers by objective measurements." The main aim of this document is not to lay down standards of excellence or figures of merit, but to encourage among electro-acoustics laboratories a common approach and viewpoint. Without these, it is notoriously difficult for laboratories to exchange information and to build up experience.

However, by defining as closely as practicable the methods of objective measurement to be followed in ascertaining loudspeaker performance, it is hoped to promote interchange of information so that data collected in one laboratory may supplement data collected in another, and be capable of assessment by all.

The kind of measurements envisaged are those which might be made, for example, when considering the approval of a production type. They are thus fairly extensive, but it is not sought to make them exhaustive.

The performance of a loudspeaker is conditioned by its acoustical environment, by programme material, and by other factors difficult to define, including the listener himself. Accordingly, tests made in a dead room can convey only a part of the information sought. The compilers of the standard recognize, therefore, that final assessment of performance must allow for subjective judgments outside the scope of the present standard.

As tests suitable for type approval are not usually adapted to routine testing, for which simpler and less detailed procedures have to be designed, these are not considered in the present standard.

Copies of this standard (B.S.2498: 1954) may be obtained from the British Standards Institution, 2 Park Street, London. W.1., for the price of 3s.

TRADE WINDS

After 16 years as managing director of the National Carbon Company, Mr. R. D. Greenwood has resigned from this position in order to take up an appointment as New Zealand Resident Director of an Australian firm of management consultants, W. D. Scott and Co.

Ron, as he is known to a very wide circle of friends and business associates in New Zealand, has seen many changes at National Carbon during his long association with the firm, having been responsible himself in 1939 for shifting the company's battery making plant from Christchurch to Wellington, and having seen a six-fold increase in the company's business since those early days of battery manufacture in this country. The battery company, he says, is on the threshold of even greater advances, as a result of its progressive policy in improving manufacturing techniques to conform with the latest developments overseas. When he first joined the firm, the making of batteries was its sole line of business, but in the intervening period he has seen the institution and expansion of considerable activity in the chemical and engineering products of the parent company in America.

Those who know him and his great interest in management, training and techniques will not be surprised to hear of his new appointment, for it is no more than a logical step, following on his formation in 1945 of the New Zealand Institute of Management. People have remarked that this body really arose inside the National Carbon Company, and Ron admits that there is more than a grain of truth in the statement. He obtained the idea for forming the Institute, directly from the internal plant training scheme which he instituted at National Carbon!

W. D. Scott & Co., with a staff of 99 (now 100, we presume) engages in giving advice to Business on management practice, with particular emphasis on methods of improvement, and their ability to do so successfully rests not only on the skill and experience of the experts they employ, but on research into the most up-to-date methods as practised all over the world. The firm constantly has members abroad engaged in research into new techniques. W. D. Scott & Co. is associated with "Allied Management Consultants," which is a group comprising the four most eminent firms of the kind, in the U.S.A., the United Kingdom, The Netherlands, and Australia.

This journal wishes Ron Greenwood as much success in his new vocation as he has had in guiding the fortunes of National Carbon.

Succeeding Ron in the managerial chair at National Carbon is Mr. D. H. Freeman, M.Sc. Mr. Freeman is already well-known to most of those with whom he will be working, as he was here eight years ago as Works Manager. Since leaving New Zealand in 1945, he has been working in Australia on the company's chemical and industrial products and has had the opportunity of visiting most of the major National Carbon Battery plants throughout the world. We wish him every success and happiness in his new appointment as General Manager of the National Carbon Company.

"NATIONAL ELECTRIC" STAFF CHANGES

With the retirement in November of popular Neil Tewsley, Auckland Manager for The National Electrical and Engineering Co. Ltd., staff changes have been made affecting a number of "National Electric" branches.

Bob Donovan, present Wellington Manager, has taken over the Auckland administration, while his place at Wellington office has been filled by Dudley Shortt, previously managing the Company's Dunedin branch. Jack Simpson, Manager at Wanganui has assumed control of Dunedin affairs, and has been replaced at Wanganui by Ivan Cosgrave, until recently in charge of Appliance Sales at Wellington branch. The Wellington Appliance division is now in the care of John Goodwin, who in turn handed over the Range Sales department to Roy Sebire. Roy's place as Wellington country traveller has been taken by Tom Easther.

Another appointment is that of Ron Airth, Wellington Lighting Department, to the newly created post of Assistant Wellington Manager.

To Neil Tewsley, our sincere good wishes for health and happiness in his retirement, and congratulations to all involved in this re-allocation of managerial and other duties.

* * * *

50th ANNIVERSARY OF THE INVENTION OF THE THERMIONIC VALVE BY SIR AMBROSE FLEMING

Apart from the demonstration of electro-magnetic waves by Hertz and their subsequent harnessing by Marconi in the service of man, probably the most fundamental discovery leading to modern radio communication and broadcasting, indeed to spectacular advances on a much wider scientific front, was made fifty years ago, last November.

In November 1904 Professor J. A. Fleming, later to become Sir Ambrose Fleming, F.R.S., who was then scientific adviser to Marconi's Wireless Telegraph Co. Ltd., in his search for a better means of detecting electro magnetic or wireless waves, produced his "Oscillation Valve," the first thermionic valve in the world.

The same basic principle on which his valve operated governs the functioning of every one of the endless array of its modern successors from the miniature valve in a pocket hearing aid to the mighty final amplifier of a broadcast transmitter which may handle up to 200 kW or more of power.

Our modern world owes much to the thermionic valve beside its well-known application in wireless communication and broadcasting. Long distance land-line telephony, television, wireless direction finding and navigational aids, aircraft control and landing systems, radar in all its manifold applications, public address systems, the modern cinema, the "electronic brain," not to mention the guided missile, and a dozen other things we take for granted could not exist without the aid of the innumerable direct descendants of Fleming's original two-electrode valve.

EARLY HISTORY OF THE THERMIONIC VALVE

Fleming's report on his experiments in a personal letter to Marconi is in the Company's achives. In it he remarks in conclusion, "I have not mentioned this to anyone yet as it may become very useful." Just how useful it was to become the future had yet to reveal.

His immediate objective had been to find a more sensitive and reliable method whereby the high frequency alterations of the feeble current in a receiving aerial could be rectified, or caused to flow in one direction only, so that the current might be capable of operating instruments such as an ordinary galvanometer, whereby the strength of the signal could be measured with accuracy.

Recalling the results of experiments which he had made some years before when associated with the original Edison Electric Light Co. of London, Fleming saw that in them lay a possible solution of his problem. These investigations had concerned the passage of electric currents through rarefied gases. It had been noted that if two electrodes were separated in a partial vacuum and one of them such as a carbon filament was made hot, current would flow across the space between them provided that the potential of the cold electrode was made positive in relation to that of the hot one. If the polarities of the electrodes were reversed no ordinary voltage would cause any current to flow at all.

Nothing was known of electrons in those days and it had been assumed that the current was conveyed by particles of negatively charged carbon thrown off from the incandescent filament. In 1899, however, Sir J. J. Thompson had proved that it was in fact particles of "disembodied electricity" unassociated with matter in atomic form and far smaller than any atoms.

Fleming connected up one of his old experimental bulbs, with its hot and cold electrodes, in a receiver circuit using a mirror galvanometer as an indicator. At the other side of the room he pressed the key of his little spark transmitter and the spot of light reflected from the mirror of his galvanometer leapt across the scale to proclaim the immediate success of the world's first wireless valve.

The Marconi Company adopted the invention at once and the "Fleming Oscillation Valve" was very soon in production.

In January 1907 an American inventor, Lee de Forest, who had been closely following this development, fitted a third electrode in an "oscillation valve" in the form of a screen or "grid" between the filament and plate. He found that, by varying the potential on this grid in relation to that of the filament, he could control the flow of electrons across the gap. Small variations of grid potential produced quite large changes in the current between filament and plate. The valve could thus be used as an amplifier as well as a detector.

De Forest's patent for this addition was at once challenged in the U.S.A. by Marconi and in several important legal actions it was established that the principle involved in the Marconi valve was fundamental, that it had priority and that the grid was merely an improvement on the basic idea.

At this period progress in wireless telephony was awaiting a practicable, reliable and reasonably cheap method of generating a constant and easily controlled train of high frequency oscillations, which could be modulated at the frequencies of sound. Various methods were being attempted. Those of the arc and of direct generation by high frequency alternator, amongst others, were meeting with qualified success but obviously they fell short, on grounds of economy and reliability, for commercial adoption on a large scale.

The three electrode valve or "triode" had been in existence for nearly five years during which the steady carrier wave that would make wireless telephony a commercial proposition still proved elusive.

Then, in 1913, with dramatic coincidence in time, it was found independently, by Meissner in Germany, Franklin and Round in England and Armstrong in U.S.A. that, by coupling the grid and the plate circuits of the triode valve in a particular way, it could itself be made to be a generator of continuous oscillations of a high frequency that was easily adjusted by the characteristics of the external circuit in which it was connected. Its oscillations were found to be steady, pure in form and easily modulated. The door was opened to the development of wireless telephony.

Eight years after its original conception by Fleming, his thermionic valve had become in succession the detector, the amplifier and at last the generator, of high frequency oscillations. The years which have since passed have seen the growth of its applications spread until life, as the civilised world knows it today, would be literally impossible without its silent service. Fleming was right. His idea has surely "become very useful."

"Radio New Zealand" Frequencies

Since Friday, 12th November 1954 (N.Z. date) "Radio New Zealand" has been transmitting in accordance with the following frequency schedule:—

TO AUSTRALIA

2000—0640 GMT	ZL19	11.83 Mc/s in 25	Metre Band
0655—Close Down	ZL18	9.52 Mc/s in 31	Metre Band

TO PACIFIC ISLANDS

1700—1930 GMT	ZL7	6.08 Mc/s in 49	Metre Band
1945—0640 GMT	ZL3	11.78 Mc/s in 25	Metre Band
0655—Close Down	ZL7	6.08 Mc/s in 49	Metre Band

Close Down is at 1045 GMT on Week-days
Close Down is at 1120 GMT on Saturdays
Close Down is at 1000 GMT on Sundays

Note particularly that transmissions to Australia and the Pacific Islands now commence at 2000 Hours GMT at 1700 Hours GMT respectively, instead of at 1800 Hours GMT.

These new commencing times will be adhered to in the future.

"R. & E." TECHNICAL PHOTOGRAPHS

Copies of original designs produced in our laboratory and featured in these pages are available. Prices are: Size 6 in. x 4 in, 3s. 6d.; 8 x 6, 4s. 6d.; 10 x 8, 5s. 6d. Please remit cash with order to Radio and Electronics (N.Z.) Ltd., P.O. Box 8022, Wellington.

AROUND AND ABOUT

PROFILE

SIR AMBROSE FLEMING, F.R.S.

Featured elsewhere in this issue is an article concerning the invention of the thermionic valve by Sir Ambrose Fleming fifty years ago.

This great scientist was born near Lancaster on 29th November, 1849. Educated at the University College School, London, he decided on an engineering career at the age of 17, and studied for his B.Sc. degree in the evening at the University of London while working during the day as a clerk on the Stock Exchange. In 1870, when not quite 21 years of age, he was one of only two students to obtain First Class Honours in the degree list.

Thus qualified, he accepted a post as Science Master at Rossall College, and, after 18 months, entered the Science Schools just established in South Kensington, studying for three years under Dr. Frankland. While there, he helped in the formation of the Physical Society, to which he read its first paper. After a short period as Science Master at Cheltenham College, he won a scholarship to St. John's College, Cambridge in 1877, and studied there under Clerk Maxwell. In 1881 he was appointed Professor of Physics and Mathematics at University College, Nottingham, soon however, accepting a post as scientific adviser to the Edison Electric Light Company.

In this capacity, he conducted the investigations to which he reverted when seeking a detector of H.F. currents some twelve years later in the service of Marconi's Wireless Telegraph Co. Ltd., to which he was appointed scientific adviser in 1899. At that time he was Professor of Electrical Engineering at University College, London. He took a leading part in the design of the powerful transmitting equipment at Poldhu, Cornwall, which Marconi was preparing for his successful attempt to span the Atlantic by wireless in 1901.

In his position at University College, Sir Ambrose trained many hundreds of engineers who later made their names in the radio industry, and his many public lectures on scientific subjects held the interest of thousands.. He continued to lecture until nearly ninety years of age, when he still displayed the wonderful energy and enthusiasm which had held his audiences spell-bound throughout his career.

After spending the last few years of his intensely active life in retirement at Sidmouth, he died there in his 96th year on 18th April, 1945.

TAPE-CONTROLLED ROBOT FACTORIES FORESHADOWED BY A FOUR-FIRM LINK-UP

The development of tape recording for the automatic operation of machine tools and the control of factory processes on a large scale is foreshadowed by a link-up of the four British firms of Grundig (Great Britain) Ltd., Smart and Brown (Machine Tools) Ltd.. Besson and Robinson Ltd., and Johnson British Electric Ltd. They are to fuse their interests, as wholly owned subsidiaries, under control of the Gas Purification and Chemical Co. Ltd., Palmerston House, Bishopsgate, London, E.C.2.

These firms state that, by virtue of their leads in the various forms of research and production in which they engage, they are specially suited to initiate together programmes of development in the fields of electronic engineering.

Grundig (Great Britain) Ltd., and Smart and Brown (Machine Tools) Ltd., bring to the country amplifications of the industrial and commercial applications of the tape recorder, in particular the working of machine tools and factory machinery by tape recorder control.

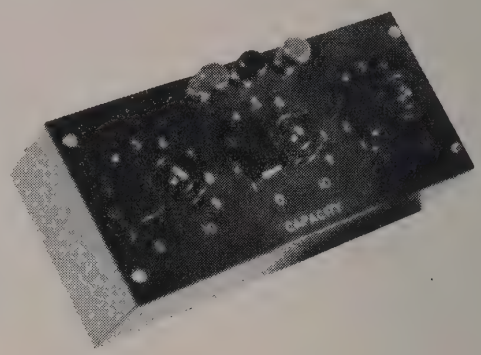
Already, as many as 50 different operations can be put into action at the same time from one tape recorder. It is claimed by the four firms concerned that the wholly or partly tape-controlled robot factory is now a possibility.

The basic idea is a simple one. A special electrical frequency is allotted to each required manual operation. Frequencies are then recorded on tape in the desired operation sequence. This "programme," as it is called, is prepared by the operator going through the production sequence manually and automatically producing a tape exactly synchronized with his operations. The recorded frequencies on the "programme" tape are then fed from the tape recorder to a series of circuits, each of which trips off a relay and moves the necessary control. For mass production, a continuous tape may be used.

There is virtually no limit to the number of operations that can be directed from the tape at any one time. In its present stage of development, this control method is most suitable for the mass production of parts used in light and heavy engineering, particularly where short runs are concerned, and the taped programmes can be prepared well in advance of any changeover.

Latest Overseas Developments

NEW DECADE CAPACITOR BOX FOR UNIVERSAL USE IN LABORATORY, TEST HOUSE, FACTORY AND SERVICE DEPOT



Winston Electronics Ltd., of Hampton Hill, Middx., England, announce the development of a new, low priced decade capacitor box making for greater saving in bulk and manufacturing costs.

The Decade Capacitor Box has proved useful in servicing deaf aids and should find wide application in electronic circuit designing and building, production control and testing, research, technical and teaching laboratories. In fact, it should find wide application everywhere electrically in many industries. The service engineer should find this small, light and extremely portable instrument particularly useful.

TECHNICAL SPECIFICATIONS

Range: 0.001 *uf.* to 1.11 *uf.* in 0.001 *uf.* steps.

Stray Capacitance: Less than 15 Pfs. per decade.

Working Potentials: 500 volts D.C., except the 0.1 *uf.* range, where it is 300 volts D.C.

Switching: Positive, firm, finger-ready, no play.

Finish: Facia Panel, photo-etched: Box, steel grey, hammertone enamel.

Dimensions: 8 in. x 3¾ in. 3 in.

Weight. 32 oz.

BACK NUMBERS OF "R. & E. R."

Back numbers are available from:

S.O.S. Radio Ltd., 283, Queen Street, Auckland.

S.O.S. Radio Ltd., 1 Ward Street, Hamilton.

Webb's Radios Ltd., 11 Wellesley St. E., Auckland.

Tricity House Ltd., 209 Manchester St., Christchurch.

Ken's Ltd., 142-144 Stuart Street, Dunedin.

Fear's Radio and Cycle Co. Ltd., 31 Willis Street, Wellington.

The Radio Service Co., 83 Guyton Street, Wanganui.

Technical Book and Magazine Co., 295-299 Swanson Street, Melbourne, Australia.

BOOK REVIEWS

LOW FREQUENCY AMPLIFICATION

By Dr. N. A. J. Voorehoeve.

INDUSTRIAL ELECTRONICS

By R. Kretzmann

(Both published by the Philips Technical Library).

These are two of the latest publications in the now well-known Philips technical library, As with all the books in the series, these two are comprehensive treatises, dealing with the subject from the practical as well as the theoretical point of view. They are liberally provided with worked out examples of designs, based on valves and other devices which appear in the wide range of Philips manufacturers. While it may be said in criticism that only one manufacturer's products are described in this way, to the exclusion of almost all others, the fact does not detract from the value of the books as works of reference. The reason is, of course, that the treatment is in all other respects completely general, and given the characteristics of other maker's valves, the reader would have no difficulty in using the information in the books to design equipment round non-Philips valves.

The first-mentioned volume covers a good deal of ground that will be familiar to most readers, but at the same time, contains much material not generally found in other text books, and it is in this direction that audio engineers will find it most useful. Unfortunately, those parts of the book which do not deal directly with valves and their circuits are somewhat sketchily handled. For example, the chapter on loud-speakers contains very little that will be of value to any but a novice, as it does little more than describe briefly the kinds of loud-speaker that exist, and the uses to which they are put. The authors would have been better advised, if material on this topic was felt to be essential in such a book, to have covered some of the operational aspects of speakers and their application; such topics as speaker baffling, treated in some detail, would have greatly enhanced the value of the book. Similar criticism applies to the section dealing with recording, which is very sketchy indeed.

The second volume would form an excellent introduction to the subject of industrial electronics, for a radio technician, or even engineer, who is interested in extending his technical horizon. The basic operation of the thyration, ignitron, and all the other members of the "tron" family, is very clearly described, and the author is careful to describe the fields of application best suited to the individual types.

The Book deals with photo-cells, and their application to industrial processes, and there is a chapter on the cathode ray tube. About half the book is devoted to descriptions, with complete circuit diagrams and illustrations of complete equipments, of apparatus designed for specific industrial purposes. A considerable range of applications is covered in this way, and this part of the book includes some excellent material on R.F. heating, both by induction and dielectric heating.

Both books should find ready acceptance by a wide circle of readers.

THE OSCILLOSCOPE AT WORK

By A. Haas and R. W. Hallows, published for "Wireless World," by Iliffe and Sons Ltd., London.

As its title implies, this book of some 170 pages is devoted to the practical application of the oscilloscope rather than to description of the design of oscilloscope circuits. After all, the instrument is only a means to an end, and we have often heard of people who, in considerable enthusiasm have built published designs of oscilloscope, and after having got them to work, have been left wondering just how to use it, and what to use it for. The instrument then gathers dust on the shelf. There should be little need to detail the various uses to which the oscilloscope can be put, for they are legion, and anyone who has become used to working one would seldom willingly be without one, even for quite simple work. It takes actual use to prove how indispensable the instrument can become, and a book such as this one is really a "must" for anyone who contemplates either buying or building an oscilloscope. In particular this one is really excellent both in content and presentation. It is full of oscillograms, photographed from the actual C.R.T. screen, showing the kind of picture to be expected in actual practice. This is a great help to those who are unfamiliar with the instrument, because the average scope rarely produces patterns that are identical with the theoretical ones. This is a book that every technician should read, whether or not he actually possesses an oscilloscope, for there is much he can learn from it about the working of well-known circuits, quite apart from its primary function, which is to enable him to get the best out of his instrument, whether home-built or commercial.

* * * *

TECHNICIAN'S GUIDE TO TV PICTURE TUBES

By Ira Remer.

HOW TO LOCATE AND ELIMINATE RADIO AND TV INTERFERENCE

By Fred D. Rowe.

(Both these books are published by John F. Rider, Publisher Inc., New York).

These two books belong to the well-known series of simplified texts aimed specifically at technicians and servicemen. Considering the tremendous advances in television techniques, and the multitude of new applications for radio-type valves in industrial equipment, and in new fields such as V.H.F. mobile equipment, it is clear that a great many technicians feel the need for new information on these new subjects, and it seems equally clear that John F. Rider is giving it to them. His earlier publications covering ordinary radio practice, and subjects like cathode ray oscilloscopes and vacuum-tube voltmeters, need no introduction to radio technicians, even in this country, and we have no doubt that those who are keeping an eye on the future will want to read these latest examples of Mr. Rider's publishing. The book on TV picture tubes is strongly to be recommended to all who are endeavouring to teach themselves something of its mysteries in our

as yet TV-less condition. All modern types are included, even to the latest tri-colour tubes for colour TV. A most useful feature is a section giving hints on the repair of minor external faults, such as those in the high-voltage connector and the graphite coating. A little knowledge here can save the life of many an expensive tube that has been bought for private experimental purposes, Similarly useful are the detailed setting-up instructions for the different types of tube, together with their associated equipment, such as ion trap magnets.

The location and curing of interference to radio receivers is a topic that servicemen seem to have left severely alone, except perhaps when they themselves have been the sufferers. This is understandable, because the localization and curing of interference is a specialized job that needs special equipment, and is very time-consuming. In addition, it is the responsibility of the Post and Telegraph Department to do this sort of work at the behest of a complainant. When TV arrives upon us, however, the interference problem will be a much more live one as far as the trade is concerned. The public will put up much less readily with visual interference effects on a television screen than they will with a few noises in a radio set, and we venture to predict that the tracking down of interference sources will become part of the stock-in-trade of those interested in the installation and servicing of television sets. Who can blame a potential customer for a TV set if a trial in his home shows that he cannot get interference-free pictures? It will thus become of vital importance to the trade to be able to tackle the interference problem. Unfortunately, very few books have been printed on the subject, and as a result, this one can expect a ready market not only in America, where it was produced. We can thoroughly recommend both these new Rider titles.

PUBLICATIONS RECEIVED

FOR REVIEW

"The Radio Constructor," Panel-Signs, Set No. 1, Receivers and Amplifiers. The Practical Electrician's Pocket Book, and Amplifiers.

"The Practical Electrician's Pocket Book, 1955": Odham's Press Ltd., England.

"Radio Laboratory Handbook," by M. G. Scroggie, B.Sc., M.I.E.E. Iliffe and Sons Ltd., England.

"Laplace Transformers for Electrical Engineers," by B. J. Starkey, Dip.Ing., A.M.I.E.E., Iliffe and Sons Ltd., England.

"Radio Valve Data," Compiled by "Wireless World:" Publishers, Iliffe and Sons Ltd., England.

"Vade-Mecum," Television and Special Tubes—P. H. Brans Ltd., Antwerp.

"Aerial," July, 1954.

"Aeromodeller," September, 1954.

"A.P.A.E. Journal," Vol. 5 No. 6, July, 1954.

"A.T.E. Journal," Vol. 10, No. 3, July, 1954.

"B.I.C.C." Bulletin, No. 12.

"Break-In," October, 1954, Vol. XXVII, No. 10.

"Boletin del Centro de Documentacion Cientifica Tecnica," Mexico, Nos., 5, 6 and 7, May, June, and July, 1954.

"das elektron," August, 1954.

"Electronic Engineering," Vol. XXVI, No. 319, September, 1954.

"Radio Electronica," August, 1954.

"Electronic Measuring," Vol. 3, No. 12.

"Elektrotehniski Vestrik," No. 5–6, 1954.

"The Gramophone," Vol. XXXII, Nos. 374 and 375, July and August, 1954.

"Electronic Application Bulletin," Vol. 15, Nos. 1/2, January/February, 1954.

"Labour and Employment Gazette," Vol. 4, No. 3, August, 1954.

National Electrical Review," Vol. 2, No. 8, September, 1954.

"N.Z. Electrical Journal," Vol. 27, Nos. 8, 9, and 10, 1954.

"The N.Z. Manufacturer," Vol. 6, Nos. 1, 2, and 3, July, August, and September, 1954.

"Ósram Bulletin," Vol. 31, No. 3, July, 1954.

"Philips Serving Science and Industry," Vol. 1, No. 1, January, 1954.

"Philips Technical Review," Vol. 15, No. 6, December, 1953.

"Q.T.S." Vol. XXXVIII, No. 8, August, 1954.

"Radiotronics," Vol. 19, Nos. 9 and 10, September and October, 1954.

"Radio Constructor," Vol. 8, No. 2, September, 1954.

"Radio and Television News," Vol. 51, No. 6, Vol. 52, No. 1, June and July, 1954.

"Service," Vol. 23, No. 8, August, 1954.

"Wireless and Electrical Trader," 14th, 21st, and 26th August, 1954.

FIRST ATLANTIC TELEPHONE CABLE IS JOINT AMERICAN-BRITISH-CANADIAN PROJECT

The Atlantic Ocean will soon be spanned by its first undersea telephone cable, which is being laid by the American Telephone and Telegraph Company.

This new cable, which is a co-operative project of the U.S. telephone company, the Canadian Overseas Telecommunications Corporation and the British Post Office, will be 2,300 nautical miles long, stretching from Nova Scotia to Newfoundland, and from there across the North Atlantic to Scotland. It will be the world's longest underwater voice cable.

In addition, it will also be the first to be laid at the great depths of over three miles found in the middle of the Atlantic. The telephone company announces that one of the biggest technical problems it had to solve was the development of amplifiers which could be laid from a cable ship and could operate without attention under the tremendous pressure of three miles of ocean water.

The cable will have 100 amplifiers, each with three vacuum tubes. Each one will be housed in a big flexible copper tube and built into the cable as a tapering bulge that will pass through the cable ship's gear as the cable is unreeled into the water.

Handling 36 separate telephone conversations at once, the cable will supplement the radio circuits now in use.

The telephone company points out that the new cable will bring greater reliability to transatlantic telephone conversations for it will be proof against the atmospheric disturbances and magnetic storms which sometimes interfere with communication by present radio circuits.

It is estimated that the telephone cable will be ready for operation in about three years.

* * * *

SUPERSONIC WASHING MACHINE IN PRODUCTION IN HUNGARY SOON

According to an announcement in the Hungarian Press, an electric sonic washing machine is about to go into serial production at the Elekthermax Factory in Papa, Hungary.

Invention of this machine was announced only last August. Clothing is washed as in other machines in a tub of detergent, but instead of using the conventional rotary apparatus to do so, the machine employs high speed sound vibrations to "shake" the dirt out.

It is stated to be more efficient and kinder to clothes than the ordinary electric washer. It does a wash in 15 minutes, and it is claimed that it uses no more power than a 40 watt light.

Now Available
SILVER CERAMIC CONDENSERS
In values from 50 pf. to 5000 pf. Prices 9d. to 1s. 4d.
Very Compact.
CAMBRIDGE RADIO AND ELECTRICAL SUPPLIES
38 Cambridge Terrace. P.O. Box 6306, Wellington. Tel. 51-209.

FOR THE TECHNICIAN

Repairs to, or Replacements of Swiss Dandy Electric Shavers, Model R.5

To enable retailers to give quick and effective service on "DANDY" Shavers, the following scheme has been evolved which will enable all Swiss "DANDY" Stockists to service Shavers in a few minutes without special tools and without any specialized knowledge, thus giving customer satisfaction and thereby building goodwill.

A suggested standard stock level of replacement parts is listed for Model R.5 and Model R.4. This can, of course, be increased at any retailer's discretion but it is suggested as an ideal minimum.

The greater majority of Swiss "DANDY" Electric Shaver faults consists of repairs or replacements to the Shaving Heads. These repairs can be carried out in a few minutes by any retailer without special tools and without any specialized knowledge or experience in Electric Shaver repairs.

When a Swiss "DANDY" Electric Shaver is brought in for service then it is a comparatively easy matter from the client's description of the fault to determine which component is defective. From there, the service scheme merely means removing the defective component assembly and replacing with a new one. If the shaver is still within the Guarantee period, then the Retailer forwards the complete defective component assembly together with the Guarantee Tag from the Shaver to RUSSELL IMPORT CO. LTD., P.O. BOX 102, WELLINGTON, and the defective component will be either replaced or reconditioned free of charge and returned to the Retailer thereby keeping his replacement stock at a constant level.

SERVICE INSTRUCTIONS R.5 MODEL

The R.5 Model is the white plastic Shaver contained in a mottled plastic carrying case.

1. **Shaving Head Faulty:** Remove complete shaving head by unscrewing from body of shaver and replace with new head. Return defective head with Guarantee Tag if under Guarantee to RUSSELL IMPORT CO. LTD., Wellington for replacement.
2. **Cutting Head Faulty:** Remove cutting head by pulling complete head away from shaver body, replace new head. Return procedure as above.
3. **Broken Switch** Toggle: Remove both shaving heads as described above, take off chrome retaining ring then with thumb-nail widen joint of the two plastic body halves, insert screwdriver and slide each half of the plastic body off. Remove toggle and replace with new one. Return procedure as above.
4. **Broken or Cracked Body Pieces:** Dismantle as above and replace broken half or halves, return procedure as above.

Faults within the Motor Assembly itself require special tools and it is not recommended to be undertaken by the Retailer unless he has the special tools and equipment required.

For faults of this nature, remove shaving heads, retaining ring and plastic bodies and switch toggle and replace defective motor assembly complete with new one. The defective Motor Assembly, together with Guarantee Tag, is then forwarded to RUSSELL IMPORT CO. LTD., Wellington, for repair and this will be returned after service.

For charge repairs, that is, replacements or repairs out of Guarantee, the Retailer is entitled to charge the retail cost of the component plus labour charge and to maintain a constant stock level. It is then recommended that the Retailer re-order the complete new component required.

R.5. MODEL:

3 x 0670 Shaving Heads.
3 x 01650 Trimming Heads complete.
3 x 2670 Chrome Retaining Rings.
3 pr. 2000 Plastic Bodies (each in two halves) Switch Toggles.
1 x 5000 Motor Assembly complete.

In general, this service scheme operates the same as the procedure outlined in detail in the Model R.5 Swiss "DANDY" Electric Shaver Manual. The adjustments which differ from the R.5 Model details are as follows.

The R.4 Model is the older type Shaver which generally has a brown plastic body and is contained in a zipped leather carrying case.

1. **Shaving Head Faulty: Same procedure as R.5** Model.

   N.B. Model R.4 and R.5 Shaving Heads are interchangeable.

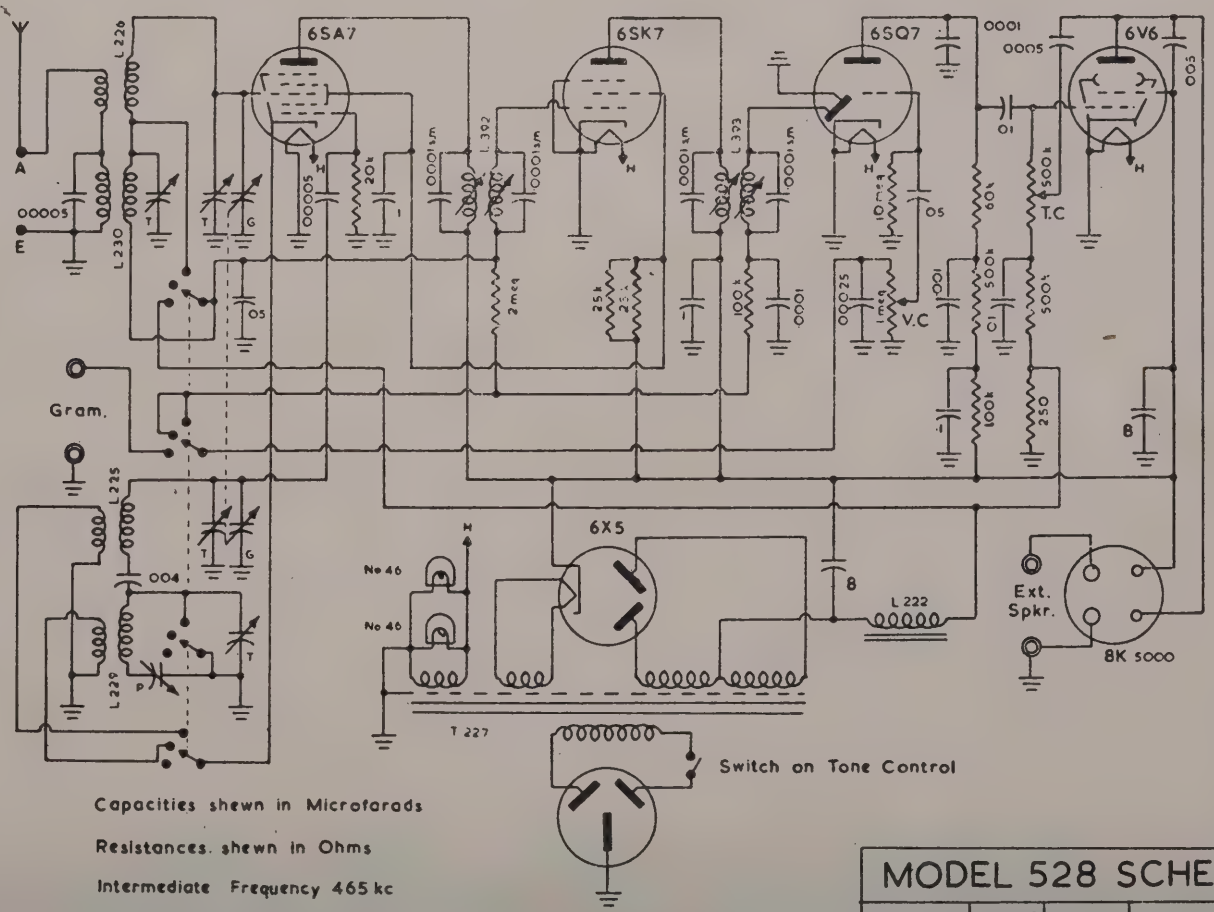
2. **Fixed or Moving Blade on Trimming Head Faulty:** Remove blade by applying pressure with forefinger. It will then be found that this will slide off easily.

   Remove fixed blade and slider and replace whichever component is faulty.

3. **Faults other than the ones outlined:** Remove Shaving Head, Trimming Head Blades, and slider then telegraph RIMCO, WELLINGTON, as follows—"FORWARD DANDY PART 4000" (signature). A complete motor unit will then be posted immediately.

   The faulty unit less all the parts removed should then be forwarded to RUSSELL IMPORT CO. LTD., P.O. BOX 102, WELLINGTON, together with the Guarantee Tag if the Shaver is still within the Guarantee period.

AKRAD RADIO CORPORATION MODEL 528



MODEL 528 SCHEMATIC			
Drawn	E.W.S.	1/9/48	DRG. NO. 472
Traced	E.W.S.	2/9/48	AKRAD RADIO CORP LTD. WAIHI
Checked	R.E.S.	6/9/48	

Push-Pull Amplifier

(Continued from Page 21.)

an input volume control, but with this amplifier circuit, ganged pots would be unnecessary. Instead, the outputs could be taken from the outside ends of two 500k. fixed resistors, substituted for the potentiometers in Fig. 4.

The latter would be a really excellent arrangement. The very high input impedance of the first stage of the amplifier is very good for the diode detector, reducing the distortion at high modulation percentages.

USE WITH THE SYNCHRODYNE

Since the synchrodyne has created such a stir, it would be as well to point out that its demodulator circuit can easily be adapted to give balanced output. This can be done simply by taking the ground off the bottom of the load resistor, and splitting the latter into two equal parts, grounding the centre point. This makes the modulator a completely balanced circuit, and the two ends of the load resistor provide the two balanced output voltages, which are fed directly to the amplifier. Doing this should improve the performance of the synchrodyne demodulator, which is supposed to be perfectly balanced, but which has to have single-ended output to suit most audio amplifiers.

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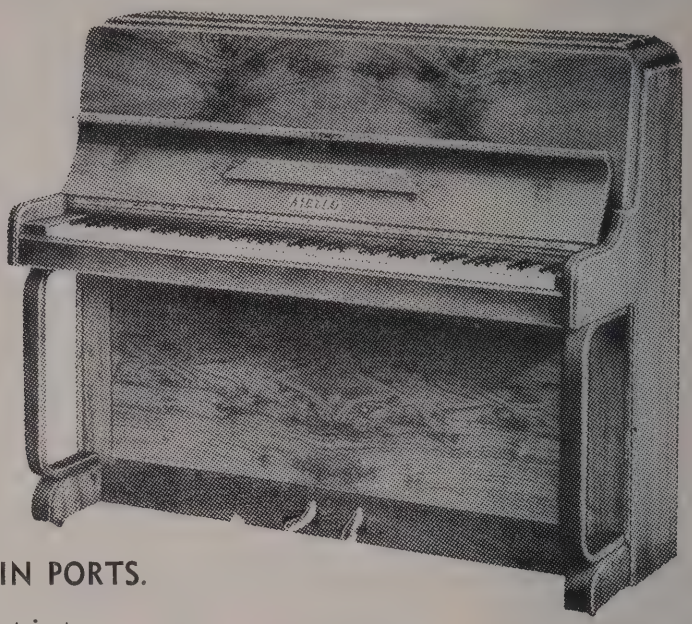

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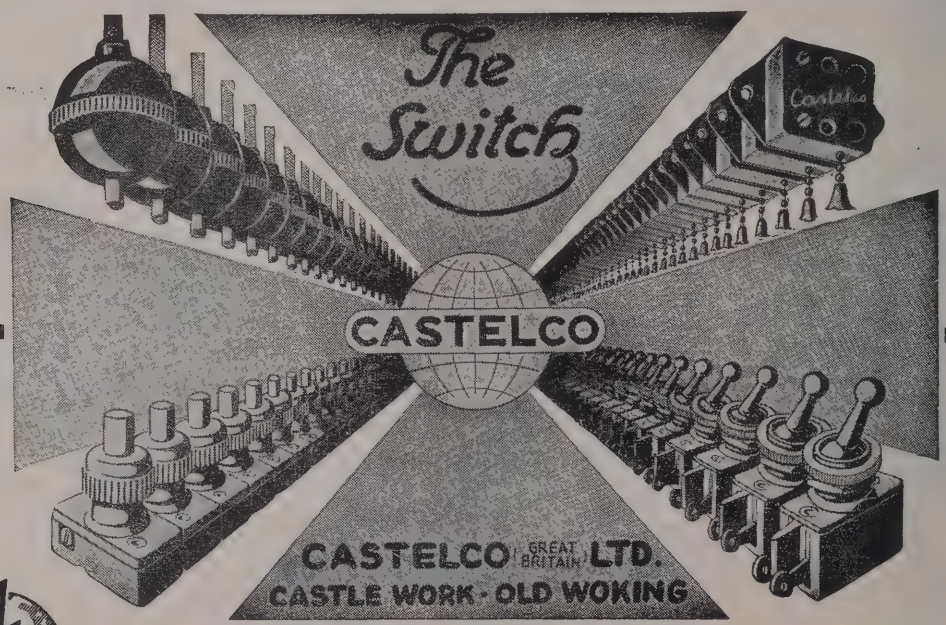

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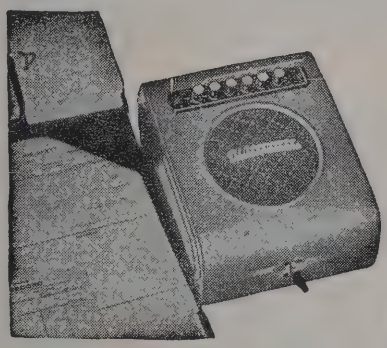
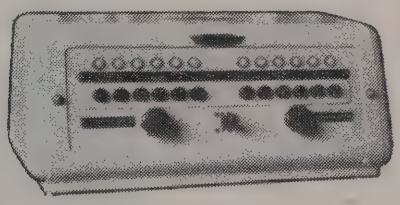
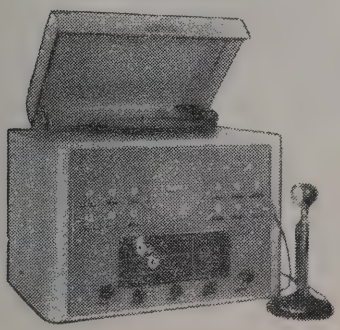


Intercommunication



Control Equipment



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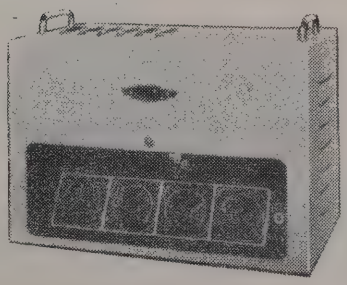

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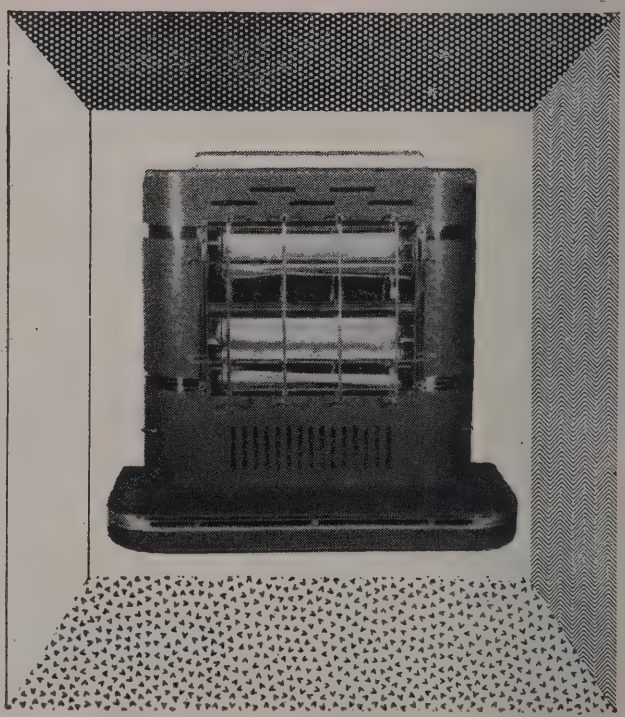

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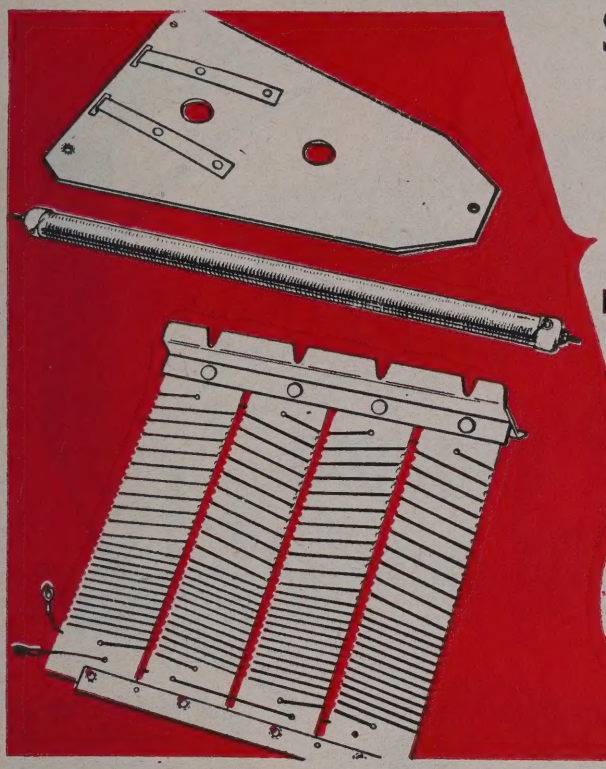

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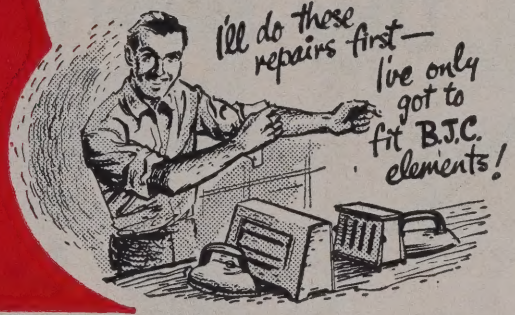

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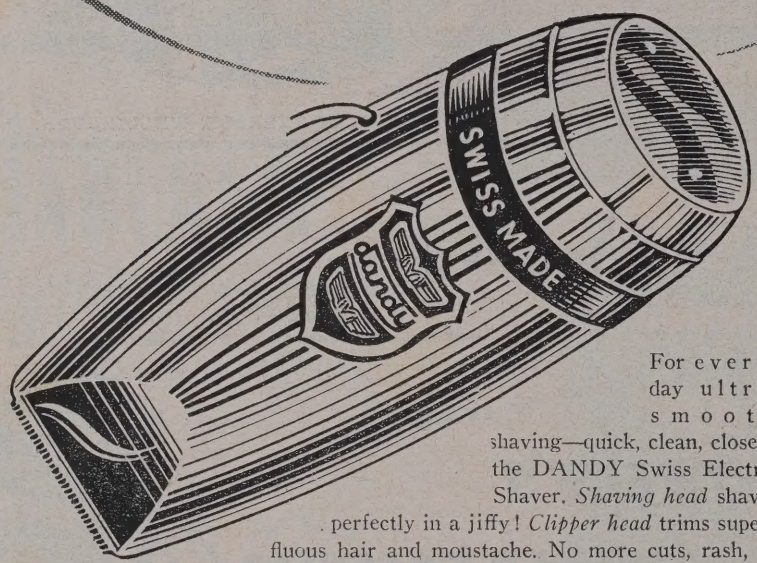

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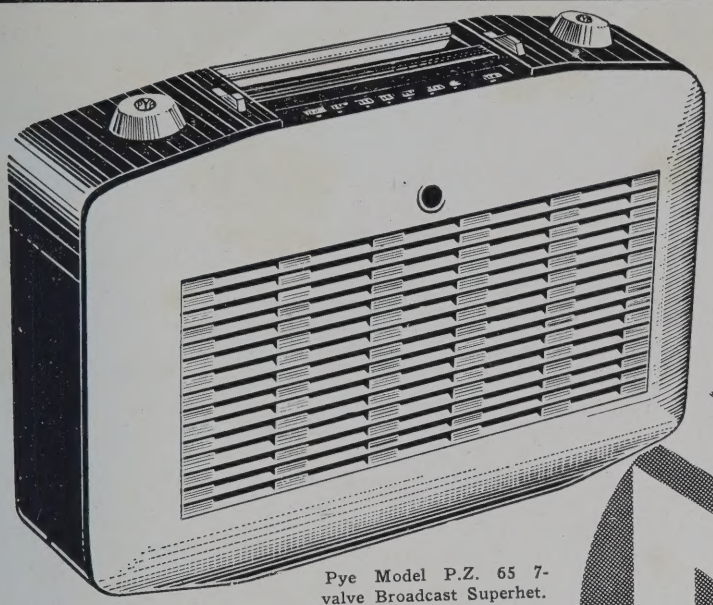

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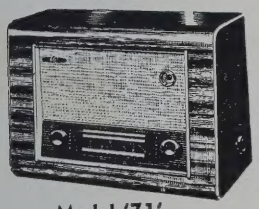

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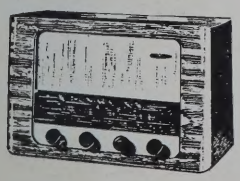

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